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ELECTRONICS AND ELECTRICAL ENGINEERING

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AMPLIFIERS

UDC 621.382.83

QUESTIONS IN THE DESIGN OF INTEGRATED CIRCUIT WIDEBAND AMPLIFIERS

Moscow MIKROELEKTRONIKA in Russian Vol 9, No 4, Jul/Aug 80 pp 369-381 manuscript received 27 Aug 79

VOLKOV, Yu. A.

[Abstract] Monolithic operational amplifiers produced at the present time are not suitable as linear broadband amplifiers in some applications: wideband amplifiers matched at the input and output with an upper cutoff frequency of 100 MHz and up; pulse amplifiers with a rise time of 10 nanoseconds and less needed for fast nuclear particle and radiation detectors, as well as video amplifiers with a cutoff frequency over 10 MHz and a low nonlinear distortion. It is expedient to break broadband amplifiers down into two classes, depending on whether or not there is a common feedback loop for the entire amplifier. Both the first type (with a cutoff frequency of 100 MHz and more) and the second (with low nonlinear distortion) are most easily designed as hybrid IC's. In an n -stage amplifier, there are 2^{n-1} ways of realizing a specified gain for an amplifier with mismatched impedances between the stages. The advantages of this mode are substantiated and its efficiency is underscored (from the viewpoint of hybrid IC reproduceability) where it is necessary to solve the problem of obtaining satisfactory frequency response and high quality matching at the input and output of the amplifier simultaneously. A specific hybrid IC broadband amplifier with an upper cutoff frequency of 200 MHz is discussed, and the stages in the design of such circuits are covered in general terms from the standpoint of the design engineer. Figures 6; tables 2; references 24: 21 Russian, 3 Western (1 in translation).

[305-8225]

ANTENNAS

UDC 621.396.677.833

AN ANTENNA WITH REMOTE EXCITATION

Moscow ELEKTROSVYAZ' in Russian No 6, Jun 80 pp 51-55 manuscript received 5 Apr 79

TIMOFEYEVA, A. A.

[Abstract] A simple small antenna has been built with a single reflector and a remote radiator, its electrical characteristics approaching those of a parabolic horn antenna. The radiator characteristics alone determine such basic performance parameters of the antenna as directivity, aperture-surface utilization factor, matching and shielding. A protective shield was added on the lower half of the paraboloidal reflector, following preliminary measurements of the radiation pattern first without and then with a small or a large shield for a comparative evaluation. The radiation pattern was also measured with cross polarization. The main lobe is almost axisymmetric and the first side lobes are deeply suppressed, to an extent which depends on the plane of measurement and polarization. The antenna has also been matched to the feed channel, and its gain characteristics are comparable with those of a standard horn antenna while its interference immunity is much higher. Figures 8; tables 2; references 6: 4 Russian, 2 Western.
[16-2415]

CERTAIN ASPECTS OF COMPUTER HARD AND SOFT WARE:
CONTROL, AUTOMATION, TELEMECHANICS, TELEMETERING,
MACHINE DESIGNING AND PLANNING

UDC 62-505.15:681.3

ON SOLUTION OF A COMPUTER-AIDED OPTIMUM CONTROL PROBLEM AND CHOICE OF THE OPTIMUM TIME QUANTIZATION FREQUENCY

Moscow AVTOMATIKA I TELEMEXHANIKA in Russian No 5, May 80 pp 57-64 manuscript received 9 Apr 79

KUNTSEVICH, V. M. and LYCHAK, M. M., Kiev

[Abstract] The paper considers the problem of synthesis of the control of a linear object described by the differential equation $\dot{X}(t) = AX(t) + Bu(t)$ where $X(t)$ is the m -dimensional vector of the phase coordinates of the system, A is a given numerical matrix of dimensions $m \times m$, B is the m -dimensional numerical vector, and $u(t)$ is the scalar control, where the pair A, B is assumed to be controllable. It is assumed that control $u(t)$ is achieved on a digital computer which, with this aim in view, generates on the basis of some program a sequence of amplitude modulated rectangular pulses with an amplitude u_n , with a constant repetition period $T(0 < T < \infty)$ and a constant duration $T_0(0 < T_0 < T)$. It is shown that it is possible to propose a formalized method for solution of the problem of the choice of an optimum value of the repetition period T with the same degree of validity as with the solution of the original optimization of the problem. The optimum time quantization frequency is determined by a method of reducing the vector-valued optimum criterion to a type of scalar indicator. An example is presented which illustrates the proposed method for solution of the problem of optimum stabilization with the aid of a digital computer of a linear object which is described by differential equations. The authors thank V. S. Besekersk for bringing to their attention during discussions at the All-Union School of Stability, Invariance and Sensitivity (Kiev, 1977) the necessity for a sound choice of the time quantization frequency. Tables 2; references: 5 Russian. [4-6415]

UDC 65.012.122:681.32

AN ALGORITHM FOR COMPUTATION OF A MULTI-CHANNEL ERLING SERVICE SYSTEM

Moscow AVTOMATIKA I TELEMEXHANIKA in Russian No 5, May 80 pp 30-37 manuscript received 18 Jul 79

RYZHIKOV, Yu. I., Leningrad

[Abstract] A completed scheme is proposed for computation of the steady state distribution of the number of customers in the system (Kendall notation) $M/E_k/n$ with an unlimited queue, as well as a method of evaluation of the truncation error of the queue, necessary during realization of the algorithm. A method is presented for computation of the time response of servicing. Modifications of the algorithm are developed for analysis of systems with a limited queue with a limited number of sources of customers (closed-loop). The numerical results of the computation are considered. A number of new applications of an iterated scheme are mentioned. Figures 2; references 5: 1 Russian, 4 Western.
[4-6415]

UDC 658.562.3.001.2:681.3

A PROBLEM-ORIENTED LANGUAGE FOR DESCRIPTION OF THE TASK OF MONITORING SPECIAL-PURPOSE MICROCIRCUITS

Moscow PRIBORY I SISTEMY ULRAVLENIYA in Russian No 6, 1980 p 33

KOL'TSOV, V. A., engineer

[Abstract] A problem-oriented language was developed at the Planning-Technological and Scientific-Research Institute (Yaroslavl') for description of problems of monitoring microcircuits with the aid of an automated monitoring system (ASK). The language suggested is an expansion of the USLOVIYE language described in 1975 by V. V. Devyatkov and A. V. Usloviye. It is intended for a description of the operating conditions of discrete control devices, a part of the dialogue automated planning the logic of discrete control devices. The expansion consists primarily of a modification of known imaging capacities to consider the peculiarities of computer control, and secondly of the addition of standard functions characteristics for microcircuit control tasks. The functions introduced include "measure," "set," "connect," "compare," etc.
[306-6508]

INCREASED PRECISION OF HARMONIC FUNCTION GENERATORS

Novocherkassk IZV. VUZ: ELEKTROMEKHANIKA in Russian No 7, Jul 80 pp 762-765 manuscript received 24 Apr 79

KUTUZOV, VLADIMIR IVANOVICH, candidate of technical sciences, acting dotsent Orenburg Polytechnical Institute; SHEVELENKO, VLADIMIR DNITRIYEVICH, candidate of technical sciences, dotsent Orenburg Polytechnical Institute; and ORLOG, IVAN PETROVICH, student, Orenburg Polytechnical Institute

[Abstract] The problem of increasing the precision of harmonic function generators (HFG) is considered. Previous investigations by the authors demonstrated that known HFG of the phase type have a significant advantage over other analog HFG with respect to the range of reproduction of modelling relationships, but the complexity of their structure does not make it possible to supply precision of modelling sufficient for a number of applications. The present paper investigates the possibility of creating the structure of a phase computer with improvement of the metrological characteristics. A HFG based on contemporary units was realized, with a compact structure containing four integrated building blocks. An experimental investigation of the HFG showed that the error of modelling multiperiod sine-cosine relations did not exceed 0.15% in the temperature range from 20 to 40°C. Thus, the phase HFG under consideration has a higher precision and speed of response and this in turn confirms the advisability of its creation and use in systems of control and modelling. Figures 1; references: 6 Russian.

[316-6415]

COMPENSATION FOR DELAYS DURING CONTROL OF MULTIDIMENSIONAL OBJECT

Novocherkassk IZV. VUZ: ELEKTROMEKHANIKA in Russian No 7, Jul 80 pp 728-735 manuscript received 20 Feb 78; after completion 12 Feb 79

BASSEYN, DNITRIY SIMONOVICH, candidate of technical sciences, dotsent, Altayskiy Polytechnical Institute

[Abstract] On the basis of a description in space conditions contained in a 1973 dissertation by the author, a general method of compensation for delays of multidimensional objects with many delays is presented, which also offers the possibility of forming controlled feedback in accordance with the vector state of the compensated object. The following items are discussed: 1) Structure of a system of automatic control; 2) Compensation of the effect of delays of an object on the stability of a control system; and 3) Working out of a system of control inputs and perturbation effects. Figures 3; references 8: 7 Russian, 1 Western.

[316-6415]

PROGRAMMABLE INSPECTION AND CONTROL OF SECONDARY ELECTRIC POWER SUPPLIES

Moscow ELEKTROSVYAZ' in Russian No 7, Jul 80 pp 44-47 manuscript received 3 Jul 79

SHCHERBAKOV, O. K. and GAVRIN, Yu. S.

[Abstract] The authors have invented a programmable device for inspection of control of electric power supplies in computer and data processing systems. It is one of 256 external users of a data processing system and interfaced with a computer memory carrying three programs for this special purpose: inspection, regulation, and digital printout or display of voltages. The output voltage can be controlled through a linear stabilizer consisting of a variable feedback resistor, or an external d.c. voltage source shunted by a potentiometer, a transistor regulator, and an error signal amplifier. The stabilizer control system includes furthermore a digital-to-analog converter. Remote control of the linear stabilizer is possible with the use of a program-controlled d.c. amplifier. Another method of regulating the power supply voltage is by means of a controlled stepper motor. The interface with the data processing system includes an input coupling to the channel, a supply selector, a code-to-analog converter, an analog-to-code converter, a digital code receiver, and an output coupling to the channel. Automatic control of electric power supplies with this device was found to greatly improve the reliability of a data processing system. Figures 7; references 6: 3 Russian, 3 Western.
[10-2415]

EXPERIENCE IN AUTOMATED DESIGN OF BILATERAL PRINTED-CIRCUIT BOARDS

Moscow ELEKTROSVYAZ' in Russian No 7, Jul 80 pp 40-43 manuscript received 17 Aug 78

OLEYNIK, B. T.

[Abstract] The system for automated design of printed-circuit boards consists of a Minak-32 computer with any memory capacity, three magnetic storage tapes, a punch-card input device, a punch-tape input device, an alphanumeric printer, an electric xy-plotter, and a drill press. The system is built in two versions, for the design of boards with two different types of through-hole patterns. The design process consists of eight steps: programmatic layout of elements with or without fixation of their locations, input of a lookup table with user's data, correction of the preliminary layout, preparation of basic data for routing, routing of internal connections, wave rerouting, semiautomatic correction of the preliminary routing, and output of control tapes for programmed automatic machine tools after second input and comparison of control sums using the "nearest town" algorithm. Experience in operation of this system has been successful, it indicates that starting with a

trial routing first is preferable to starting with a wave routing. The average data preparation time is 2 h and the computer works 2.5 h, of which 1.5 h are spent on design calculations and the rest of the time on data exchange with peripheral equipment. Fabrication of a photoprocess template on glass requires 5 h. Because the Minsk-32 is a multiprogram computer, it is possible simultaneously to design two printed-circuit boards. References: 10 Russian.
[10-2415]

CERTAIN ASPECTS OF PHOTOGRAPHY, MOTION PICTURES AND TELEVISION

AUTOMATIC MEASUREMENT OF THE QUALITATIVE INDICES OF A TELEVISION CHANNEL

Moscow VESTNIK SVYAZI in Russian No 6, Jun 80 pp 22-24

DVORKOVICH, V. P., candidate of technical sciences, senior scientific-research worker, Scientific-Research Institute of Radio (NIIR)

[Abstract] The K2-35 digital automatic measurer of the parameters of television channels was developed and is series produced for measurement of a TV channel, both in the process of transmission and during preventive maintenance. Use of the K2-35 makes it possible to reduce considerably the measurement time with a very high precision of measurement. This plays an important role in the improvement of the operation of the means for TV broadcasting. In order to use the K2-35 effectively, it is necessary for maintenance personnel to know the methods used in the device for processing measuring signals during determination of the 26 qualitative indices of a TV signal. These methods are described. A photograph of the K2-35 is presented.

Figures 4.

[320-6415]

RADIO ASTRONOMY

UDC 522.2:523.164

SOME QUESTIONS IN THE GENERATION OF DIRECTIONAL PATTERNS USING APERTURES WITH ONE PLANE OF SYMMETRY

Gor'kiy IZV. VUZ: RADIOFIZIKA in Russian Vol 23, No 4, 1980 pp 393-397 manuscript received 13 Aug 79

MOROZOVA, I. A., Main Astronomical Observatory, USSR Academy of Sciences

[Abstract] There are two ways of producing an image in radio astronomy: the first is predicated on knowledge of the directional pattern of the telescope antenna; the second utilizes knowledge of its spatial frequency characteristics. The latter case is analyzed here through a further refinement of the method of spatial frequency filtering where the aperture being synthesized has one plane of symmetry. It is assumed that the aperture is irradiated uniformly and in-phase. A convolution theorem is the basis of a system for reading out the spatial frequencies from the 'center of mass' of the aperture. Five aperture shapes (from a rectangle which is curved to varying degrees plus a half-ring and a semi-circle) are studied by means of optical modeling using a point source of incoherent light to illustrate the proposed approach. Fraunhofer diffraction patterns are shown for the various aperture configurations, and these exhibit complete agreement with theory for the case of the half-ring aperture. Thus, finding the frame of reference for the spatial frequencies in two orthogonal directions for a radio telescope antenna is an important step in analyzing apertures with a single plane of symmetry, because autoconvolution of the aperture distributions cannot be replaced here by autocorrelation. Taking the specific features of the spatial frequency response shaping by such apertures into account will permit their most efficient use. The author expresses his deep appreciation to G. B. Gel'freykh, N. M. Tseytlin, A. N. Korzhavin and V. I. Turchin for helpful comments. Figures 5; references 3: 1 Russian, 2 Western.
[245-8225]

UDC 681.142-523.8.621.372

AN EFFECTIVE METHOD OF ANALYSIS OF NONLINEAR RESISTIVE NETWORKS

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 7, Jul 79 pp 60-63 manuscript received 21 Feb 79; after revision, 5 Jul 79

PETRENKO, A. I. and GUMEN, N. B.

[Abstract] Known methods of piecewise-linear analysis of nonlinear networks present certain difficulties related to the description of the piecewise-linear model, particularly the areas of the euclidean space within which the nonlinear network is considered linear, the boundaries of these areas and formation of piecewise-linear equations. The use of simplexes and the procedure of simplex subdivision eliminates these difficulties. The present article describes this method of analysis of a network by piecewise-linear approximation of a multidimensional function realized by the network. Experimental studies show that an alteration of the structure of RL in order to consider local properties of the function and adjustment of the model on this basis cuts the computation time approximately in half. The use of simplexes in this stage still further simplifies the procedure for determination of the boundaries. Tables 1; references 7: 1 Russian, 6 Western.

[309-6508]

UDC 621.391.2

THE RECEPTION NOISE IMMUNITY OF DIGITAL SIGNALS AGAINST A BACKGROUND OF PULSE
INTERFERENCE

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 4, Apr 80 pp 35-39 manu-
script received 11 Mar 79

SMIRNOV, V. A. and EFENDIYEV, R. N.

[Abstract] The realization of a random process which takes the form of an additive mixture of a useful signal, chaotic pulse interference and steady-state white noise is received during an observation interval. An optimal receiver for the discrete signals is proposed on the basis of equations derived for optimal filtering using Markov nonlinear filter theory. The difficulty of analytically calculating the probabilistic characteristics of optimal reception using the derived formulas for the case of chaotic pulse interference is circumvented by a computer program, which solves the stochastic differential equations using Euler's method. It is assumed for the computer modeling that the number of discrete signals in the overall realization is 10^3 for each fixed value of the parameter defining the noise and interference signal. The configuration of the optimum receiver is shown by a block diagram and the error probability is plotted from the computer run as a function of the signal-to-noise ratio for various ratios of the amplitudes of the pulsed interference and the useful signal. The noise immunity calculations show that the use of optimal reception techniques with pulse interference compensation allows for a significant improvement in the reception characteristics of discrete signals subject to jamming. An experimental confirmation of the proposed procedure is noted for the case of amplitude keyed signals received in white noise, where the theoretical results given in the literature agree with the values calculated here for the case of no pulse interference. Figures 3; references: 4 Russian.
[258-8225]

SIGNAL DETECTION WITH FREQUENCY SELECTIVE FADING IN NOISE HAVING AN UNKNOWN SPECTRUM

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 4, Apr 80 pp 93-95 manuscript received 19 Mar 79; after revision 22 Jun 79

SAVINA, A. I.

[Abstract] The problem of signal detection subject to frequency selective fading in the transmission channel is analyzed given the following: the function representing the frequency response of the transmit channel is an a priori unknown; the interference is additive Gaussian noise with an unknown power spectrum; the signal process is observed at the output of a matched filter incorporated in the receiver; the duration of the signal is much greater than that of a scattering interval of the transmission channel and the resolving power of the signal is much less. The signal is detected in two stages: 1) Various frequency components are subjected to binary quantization for decision making concerning the presence of a signal component at the given frequency; and 2) The combining of the preliminary decisions at all frequencies in order to draw a final conclusion on the presence or absence of the signal. The rule for the binary quantization is found, where this rule is invariant with respect to a change in the frequency response of the transmit channel. The statistics governing second stage decision making are also formulated and a block diagram of a device realizing the final algorithm is shown; it contains a matched filter, gating circuitry, fast Fourier transform circuits, adders and various threshold gates. The detection algorithm in this case satisfies the requirements of invariance with respect to the a priori unknown parameters of the transmit channel and the noise spectrum. The false alarm probability is independent of a change in the noise spectrum, and in the class of rules with preliminary quantization of the spectral estimates of the processes, the algorithm guarantees a maximum detection probability for any signal to noise ratio. Figure 1; references: 2 Russian. [258-8225]

A STUDY OF THE SENSITIVITY OF SIMULTANEOUS DETECTION AND ESTIMATION ALGORITHMS TO A CHANGE IN THE A PRIORI DATA

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 4, Apr 80 pp 78-81 manuscript received 14 May 79

SHAKHURIN, A. P.

[Abstract] Although simultaneous detection and estimation systems are more efficient than systems where these functions are separated, it is important to know which parameters of the a priori information have the greatest impact on the adaptive algorithms used in these cases. Statistical tests are used to evaluate Bayes

algorithms for simultaneous detection and estimation of a Gaussian Markov signal in white noise, where the signal statistics are completely known. It is assumed that information on parameters characterizing the drift and diffusion coefficients as well as the a priori probability of the presence of a signal are not known. The sensitivity of Bayes algorithms is analyzed for various kinds of relationships between the detection and estimation operations; the most critical parameters, which when unknown exert the greatest influence on processing quality, and which are to be the basis for subsequent adaptation, are ascertained by means of the statistical tests. The results are presented graphically showing the relative error as a function of parameter mismatching; with complete a priori ignorance of the signal presence probability parameter, the error reaches considerable levels, although there is a rather wide range of insensitivity in which nonoptimal algorithms are not greatly inferior to optimal ones in terms of risk. Figures 1; references: 3 Russian.

[258-8225]

UDC 621.391.26

STABLE METHOD FOR DETERMINING SIGNALS AGAINST A BACKGROUND OF NOISE (SURVEY)

Moscow AVTOMATIKA I TELEMEXHANIKA in Russian No 5, May 80 pp 65-68 manuscript received 13 Jul 79

KRASNENKER, V. M.

[Abstract] Papers (approximately five-sixths non-Soviet) concerned with stable (robust) detection of signals against a background of noise are surveyed. The object of the survey is, in order to supplement the paper by A. A. Yershov, Stable Methods of Evaluating Parameters (Survey), Avtomatika i Telemekhanika, No 8, pp 66-100, 1978, to point out current approaches to stable detection of signals and briefly to describe the principal results obtained from them with references to specific original works. The survey contains the following sections: 1) Introduction; 2) Stable Detectors Using the Minimax Neumann-Pearson Law; 3) Asymptotic Optimum Stable Detectors. Use of Theory of Khuber M-Evaluations in Detections; 4) Stable Suboptimum Detectors and Quantizers; 5) Sequential and Adaptive Procedures in Stable Detection; 6) Stable Detection in Quasi-Determinate and Stochastic Signals; and 7) Experimental Investigations. Figures 9; tables 2; references 138: 22 Russian, 116 Western.

[4-6415]

METHODS OF SIGNAL PREDISTORTION AND EQUALIZATION IN INFORMATION TRANSMISSION SYSTEMS (REVIEW)

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 4, Apr 80 pp 5-15 manuscript received 9 Apr 79; after revision 30 Jul 79

MARIGODOV, V. K.

[Abstract] In briefly tracing the history and theory of predistortion and equalization methods used to improve communications systems performance, a basic trend is noted: conventional linear equalization of a channel was the starting point for procedures which later took into account the noise and interference situation, and finally culminated in the appearance of adaptive systems having a control channel as well as feedback channels. The latter class of systems receives primary attention of this paper following a general discussion of the classification of methods of nonadaptive predistortion and equalization. The treatment of adaptive systems uses examples of television systems with adaptive horizontal sweep distortion and equalization and a data transmission system utilizing adaptation for a nonsteady-state channel. The general mathematical expressions for such efficiency criteria as the gain in the signal-to-noise ratio, the minimum mean square deviation of the received signal from the transmitted one and the probability ratio criterion showing how many times the average error probability is reduced through the use of predistortion and equalization are adduced. The potential noise immunity of adaptive systems is illustrated by an example showing that for a Soviet standard TV system, adaptive predistortion and equalization of the video signal is 8 times more effective than conventional techniques, even in the worst case. The paper focuses primarily on Soviet literature and provides no detailed figures on the performance of any particular communication system. Figures 5; references 67: 58 Russian, 9 Western.

[258-8225]

STABLE SOLUTION OF THE NONLINEAR FILTERING PROBLEM IN DISCRETE TIME

Moscow AVTOMATIKA I TELEMEXHANIKA in Russian No 5, May 80 pp 99-105 manuscript received 24 Mar 79

SHAPIRO, Ye. I., Moscow

[Abstract] An approximate solution is given to the problem of nonlinear filtration. A non-Gaussian model of the errors of the results of observation is used, which contains a powerful additional noise. The problem of evaluation of the vector of the

state of the useful signal X_1 by the results of observation y_1, \dots, y_1 is considered. Because the probability distribution of the signal and noise are given, it is possible to use a Bayes' approach to a solution of the problem of evaluation. The Bayes' recurrent solution of the filtration problem is obtained. The structure of the Bayes' evaluation is determined and the recurrent algorithm for computing the a posteriori probability density is obtained. Because the Bayes' solution is cumbersome, a stable recurrent solution of the problem of nonlinear filtration is obtained. During construction of a stable filter an approach shown in the literature is used for the case of linear scalar processes. A stable solution is obtained for the problem of filtration in the case of a linear model. References 5: 3 Russian, 2 Western.
[4-6415]

UDC 621.391:519.27

THE DETECTION OF A SIGNAL COMPONENT IN A POISSON PULSE TRAIN OF UNKNOWN INTENSITY

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 4, Apr 80 pp 110-112 manuscript received 1 Mar 79; after revision 27 Aug 79

VOSTRETISOV, A. G. and KUSHNIR, V. I.

[Abstract] The problem of detecting a signal in a Poisson flow of indistinguishable pulses under conditions of a priori indeterminacy with respect to its signal and background components is solved with an adaptive detection algorithm based on one which is optimal in terms of the Neuman-Pearson criterion. The background intensity parameter in the latter algorithm is replaced by its estimate. The time interval over which the estimate is computed is taken as much greater than the time the signal acts. Analytical expressions are derived for the false alarm and target loss probabilities, and these probabilities are also shown graphically for various values of the sample volume as a function of the noise intensity. Figures 1; references: 4 Russian, 1 Western in translation.
[258-8225]

THE PASSAGE OF SEVERAL NORMAL RANDOM SIGNALS THROUGH A DEVICE WITH COMPLEX NON-LINEARITY

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 4, Apr 80 pp 82-88 manuscript received 2 Jan 79; after revision 30 May 79

DEYEV, V. V.

[Abstract] In multichannel radio engineering systems, several signals at different frequencies pass through a device having a complex transmittance which can be written as a function describing the distortion of the amplitude of the input signal and the phase distortion caused by AM to PM conversion. Although an expression has been derived in the literature for the correlation function of the output voltage with the amplification of the sum of quasi-determinant signals of constant amplitude and random initial phase, this paper determines the correlation function for the voltage at the output of such a device when several independent steady-state narrow-band random signals which are separated in frequency and have different dispersions are present at the input. No limitations are placed on the spectral width of the partial input signals. In the case of spectral overlapping of the wideband signals, the individual components at the output can be segregated following frequency compression by means of a correlator. The detailed mathematical treatment yields formulas for the dispersion of any component of the output voltage, where the device characteristic is specified in the form of a power series. The derived formulas are convenient for practical applications and an example of their use in the study of the transmission of several random signals with one of them predominating is given; the specific example is an amplifier designed around a UV205 traveling-wave tube. The optimum signal-to-combined noise ratio is found here as a function of tube and signal parameters. Figure 1; references 6: 5 Russian, 1 Western. [258-8225]

ADAPTIVE FILTERING OF A MESSAGE WITH UNKNOWN STATISTICAL CHARACTERISTICS

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 4, Apr 80 pp 40-45 manuscript received 19 Mar 79; after revision 24 Sep 79

PEROV, A. I.

[Abstract] Although a Kalman filter theoretically yields an unbiased estimate of a message based on the criterion of a minimum dispersion of the filtering error for a linear message model, where the message is observed against a background of additive white noise, it is assumed that the statistical characteristics of the message and noise are known. In practice, these characteristics can be a priori unknowns.

In many cases the adaptive filters employed to overcome this difficulty are based on the assumption that the a posteriori distribution of the message and the parameters describing it statistically are Gaussian. Equations are derived in this paper for the adaptive filtering of continuous and discrete messages with a priori unknown statistics. The useful message is described by either one or several components of a multidimensional Markov process. The algorithms found for the optimal Kalman filters are applied to the case of adaptive filtering in discrete time where the Markov process describes either the range to the target or the angular coordinate, and the unknown parameter is the spectral density of the process. The resulting filter was modeled on a computer and the average estimates of the normalized spectral density are shown graphically as a function of time. The curves show that the estimate of the unknown parameters converges to the true value. The adaptation time amounts to 5 to 10 seconds for a strong signal (where the true spectral density is twice the average value) and 10 to 30 seconds where the true spectral density is 20% of the average. Figure 1; references: 6 Russian.
[258-8225]

UDC 621.396.621

THE OPTIMUM KEYING ANGLE IN SYSTEMS WITH PHASE KEYED SIGNALS

Kiev IZV.VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 4, Apr 80 pp 104-105 manuscript received 15 Feb 79

KOVAL', A. V. and PEREVERTUN, V. V.

[Abstract] The distribution of the total signal power between the information and synchronization channels exerts a substantial influence on the noise immunity of the quasi-coherent reception of phase keyed signals. The two most widespread approaches to this power distribution are: 1) Splitting off part of the power for a pilot signal which is inserted in the phase keyed signal and then used as a reference signal at the receive end; and 2) Using phase keying with an angle of less than 180° . The carrier appearing in the signal spectrum is used in this case to generate the reference frequency. This paper analyzed the latter case to find the optimum keying angle for small signal-to-noise ratios. It is assumed that the system employs a phase-locked loop and expressions are then found for the average error probability. The derived equations are illustrated graphically by a computer run which plots the error probability as a function of the keying angle for various signal-to-noise ratios in the receiver channel. These equations can be used in the design of adaptive systems in which the keying angle changes as a function of the signal-to-noise ratio. Figures 2; references 4: 3 Russian, 1 Western.
[258-8225]

THE FLICKERING OF OPTICAL IMAGES OF LASER SOURCES IN A TURBULENT ATMOSPHERE

Gor'kiy IZV. VUZ: RADIOFIZIKA in Russian Vol 23, No 4, 1980 pp 461-469 manuscript received 10 Apr 79

MIRONOV, V. L., NOSOV, V. V. and CHEN, B. N., Institute of Atmospheric Optics, Siberian Department, USSR Academy of Sciences

[Abstract] The wave field incident to a receiving telescope has a complex amplitude in the plane of the origin, where the receiving lens is located, with a specified amplitude transmittance and a focal distance. The random shifts in the image of the source are characterized in terms of the coordinates of the center of mass of the intensity distribution in the focal plane of the telescope. The dispersion of the flickering of the optical image is theoretically analyzed based on an earlier theory of V. I. Tatarskiy ["Rasprostraneniye voln v turbulentnoy atmosfere," Moscow, Nauka Publishers, 1967]. Primary attention is devoted to a study of the dispersion as a function of beam divergence caused by the turbulence of the medium and diffraction in the radiating aperture. The structural function of the phase fluctuations of the beam needed for the dispersion calculation is specified in two ways: 1) Based on ray representations; and 2) Assuming the log normality of the intensity fluctuations. Both of these approaches yield close results. Depending on the extent of beam widening, the dispersion of the image flickering can exceed a value corresponding to a plane wave, and can be less than the value associated with a spherical wave. The relevant explicit analytical expressions are given, though no sample calculations are shown. References 18: 15 Russian, 3 Western. [245-8225]

WAVE-INTENSITY FLUCTUATIONS IN A ONE-DIMENSIONAL RANDOMLY INHOMOGENEOUS MEDIUM. III. THE INFLUENCE OF ABSORPTION AND THE TRANSFER EQUATIONS

Gor'kiy IZV. VUZ: RADIOFIZIKA in Russian Vol 23, No 4, 1980 pp 432-441 manuscript received 10 Apr 79

BAKIN, G. I. and KLYATSKIN, V. I., Pacific Oceanological Institute, Far East Scientific Center, USSR Academy of Sciences

[Abstract] Previous papers in this series [IZV. VUZ: RADIOFIZIKA, Vol 22, Nos 2, 5, 1979] have treated the problem of wave propagation in a one-dimensional, randomly inhomogeneous medium without attenuation. These articles dealt with wave-intensity fluctuations inside a layer and the impact of the boundary conditions on them. Such a formulation represents only the limiting case of a real problem which takes into account wave attenuation, i.e., where the wave is slightly attenuated

over distances on the order of the layer thickness, L . In contrast, this paper covers wave attenuation over distances substantially less than L , and it is shown that where the reflection factor, R_L , is known, the problem of wave propagation in a one-dimensional layer of this type can be reduced to a Cauchy problem. The problem is posed in such a manner with the wave incident to the layer from the right that the conditions placed on the left side boundary can be neglected. With this formulation, it is easy to go to the limit where the layer thickness approaches infinity, since in this case, a steady-state distribution exists for R_L . A closed equation is found for the probability density which defines the statistical characteristics of the wave intensity inside the layer. Expressions are derived for the cases of both weak and strong attenuation. References 12: 7 Russian, 5 Western. [245-8225]

UDC 538.56:519.25

NONSTEADY-STATE PROBLEMS OF MULTIPLE SCATTERING OF WAVES IN A ONE-DIMENSIONAL RANDOMLY INHOMOGENEOUS MEDIUM

Gor'kiy IZV. VUZ: RADIOFIZIKA in Russian Vol 23, No 4, 1980 pp 442-451 manuscript received 26 Mar 79

ABRAMOVICH, B. S. and GUREBTOV, S. N., Radiophysics Scientific-Research Institute

[Abstract] The statistical properties of signals reflected from a one-dimensional layer with small scale random inhomogeneities of the dielectric permittivity are studied. It is shown that in order to find the average form of the reflected pulse, it is sufficient to know the average reflection factor at only one frequency, and thus in order to study the mean linear characteristics of the reflected signal relative to the field, the problem essentially reduces to solving the steady-state case. Finding the energy characteristics of the reflected wave requires the solution of an independent problem involving the determination of the correlation function or reflection factor at different frequencies, because it is not sufficient to know the statistical properties of the reflection factor at one frequency. The solution of this problem is subsequently utilized in order to determine the average intensity and intensity moments of a quasi-monochromatic signal reflected from an inhomogeneous layer with a reflector at the far boundary. The specific features of modulated signal reflection from optically long layers are also treated, and in this case, the frequency correlation function can be represented in the form of an infinite continued fraction, while the modulation of the radiation leaving the layer is determined by the statistical properties of the medium. The entire analysis is based on a diffusion approximation of the local reflection factor. It is also shown that multiple wave scattering at inhomogeneities in the medium leads to an exponential rise in the time moments of the reflected pulse intensity with an increase in the optical thickness of the layer. Figures 2; references 7: 4 Russian, 3 Western. [245-8225]

THE SPACE-TIME CHARACTERISTICS OF NONLINEAR RANDOM WAVES IN NONDISPERSIVE MEDIA

Gor'kiy IZV. VUZ: RADIOFIZIKA in Russian Vol 23, No 4, 1980 pp 452-460 manuscript received 29 Mar 79

GURBATOV, S. N., Gor'kiy State University

[Abstract] The space-time correlation functions and the spectra of plane nonlinear waves in a nondispersive medium with an infinitely small high frequency dissipation factor are studied. The evolution of the space-time characteristics of a random wave at the input, both at distances less than the characteristic wavelength of discontinuity formation and in the region of developed discontinuities is analyzed. Analytical expressions are derived for these correlation functions and spectra of nonlinear random waves at spatially separated points, and it is demonstrated that nonlinear interaction leads on the one hand to an increase in the wave correlation time at spatially separated points, and on the other, to a reduction in the correlation at these points. Discontinuities are also found qualitatively to change the space-time correlation functions and spectra of the nonlinear waves. Graphs are plotted which show the evolution of the cross-correlation function as a function of time for various input correlation functions. It is also noted that the analysis of the space-time characteristics can be applied to nonlinear cylindrical and spherical waves with the appropriate substitution of variables. Figure 1; references: 8 Russian.
[245-8225]

EQUATIONS FOR THE INTENSITY MOMENTS OF RADIATION IN BROKEN CLOUD COVER IN A MARKOV APPROXIMATION

Gor'kiy IZV. VUZ: RADIOFIZIKA in Russian Vol 23, No 4, 1980 pp 424-431 manuscript received 2 Apr 79

GLAZOV, G. N. and TITOV, G. A., Institute of Atmospheric Optics, Siberian Department, USSR Academy of Sciences

[Abstract] The recent increased interest in radiative transfer in stochastic macroinhomogeneous media is caused by such problems as energy transfer in broken cloud cover, nuclear reactor shielding and wave agitation of the sea surface. The study of solar and laser radiation transfer in broken cloud cover has been stimulated by the needs of actinometry, as well as LIDAR [Laser Infrared ra DAR] and atmospheric energy exchange and circulation theories. Because the description of radiation intensity in broken cloud cover is not yet amenable to analysis of distribution functions, intensity moments are of the greatest interest at the present time. Equations were derived in previous literature for these moments by starting from a

stochastic transfer equation for the special model of the medium, which is used here, and which corresponds quite well to the structure of broken cloud cover and certain other media. Equations were obtained for the first moment and the correlation function of the intensity by means of spatial averaging. This approach is limited: because of the specific features of the averaging, only the case of a statistically plane homogeneous medium and uniform boundary conditions is covered, the derivation becomes increasingly cumbersome with an increase in the order of the moment and assumptions are used, the physical and statistical meanings of which are not altogether clear. This paper proposes a method for the derivation of the equations of intensity moments of any order in a Markov approximation which is free of these drawbacks. A recurrent algorithm is given for the moment calculations. Figure 1; references 16: 15 Russian, 1 Western (in translation). [245-8225]

UDC 621.371.25

ON A SPECIFIC FEATURE OF RADIO WAVE CAPTURE IN IONOSPHERIC WAVEGUIDE CHANNELS IN THE CASE OF QUASI-TRANSVERSE PROPAGATION

Gor'kiy IZV. VUZ: RADIOFIZIKA in Russian Vol 23, No 4, 1980 pp 495-497 manuscript received 14 May 79

AL'BER, Ya. I., YERUKHIMOV, L. M., KARENIKOVA, I. R. and URYADOV, V. P., Radio-physics Scientific-Research Institute

[Abstract] Aspect scattering of radio waves at ionospheric inhomogeneities oriented along geomagnetic lines of force can be an effective mechanism for capturing the waves in trajectories representing low attenuation modes in ionospheric waveguide channels (IWC's). The azimuthal characteristics of the scattered waves should play a substantial part in this capture. These characteristics are determined by the spectral density of the plasma fluctuations as a function of the wave numbers transverse to the geomagnetic field. The case of quasi-transverse (relative to the magnetic field) propagation can be of particular interest, and accounting for the polarization of the incident wave becomes important in the calculation of the scattered energy. This paper employs a Born approximation for various kinds of spectral functions of the plasma density fluctuations in order to calculate the azimuthal characteristics of the capture coefficient for radio waves in an IWC, for the case of quasi-transverse propagation. The analysis applies to capture at frequencies above the E and F₂ layer maximum usable frequencies. The derived analytical expressions are applied to a computer program to calculate the capture coefficient as a function of the azimuthal angle for conditions of the nighttime ionosphere at upper latitudes (65°) around a frequency of 13 MHz. The capture coefficient is plotted graphically to illustrate the impact of polarization, which is shown to be considerable. Figures 2; references: 9 Russian. [245-8225]

ON THE QUESTION OF THE ATTENUATION OF ION SOUND WAVES IN THE F-LAYER OF THE IONOSPHERE

Gor'kiy IZV. VUZ: RADIOFIZIKA in Russian Vol 23, No 4, 1980 pp 499-502 manuscript received 10 Jul 79

TOLMACHEVA, A. V., Gor'kiy State University

[Abstract] When high-power shortwave radiation acts on the ionosphere, artificial periodic inhomogeneities are produced below the reflection point, where the occurrence and disappearance of these inhomogeneities in the F layer are related to the excitation of rapidly decaying ionic sound with a characteristic relaxation time of 20 to 30 nsec. The attenuation of the sound can be related to the transmission of wave energy to molecules because of collisions with charged particles, with the absorption of this energy by the charged particles, and finally, to the departure of the waves from the region considered. Noncollision attenuation should make the greatest contribution to the attenuation of the F-layer, where the attenuation depends on the ratio of the electron to the ion temperature. A comparison of calculated values of the noncollision attenuation characteristic time with the experimentally measured times can yield useful information on these ionospheric parameters. This paper analyzes the specific features of ionic sound in the geomagnetic field with collisions between ions and molecules, the accounting for which is necessary in the lower level of the F-layer; the analysis starts with the well-known dispersion equation. Analytical expressions are derived for the attenuation at altitudes of 250 - 300 km and 180 - 220 km, and the behavior of the attenuation in these regions is discussed. The authors thank V. V. Selikovich, Ye. A. Benediktov and B. N. Gerslman for discussion of the results of the work. Figures 2; references 6: 5 Russian, 1 Western.
[245-8225]

ON THE APPLICATION OF THE METHOD OF PERTURBATIONS TO THE CALCULATION OF THE TRAJECTORY OF A RAY IN A HORIZONTALLY INHOMOGENEOUS IONOSPHERIC LAYER

Gor'kiy IZV. VUZ: RADIOFIZIKA in Russian Vol 23, No 4, 1980 pp 498-499 manuscript received 4 Apr 79

TININ, M. V., Irkutsk State University

[Abstract] The method of perturbations can be applied to trajectory calculations in order to yield extremely simple expressions in an optical geometric approximation for the variations in the arrival angles, the amplitude, the propagation time and other characteristics of radio waves in an inhomogeneous medium. The use of the

technique to account for the influence of horizontal inhomogeneity of an ionospheric layer runs into difficulties related to the instability of quasi-critical rays; this paper circumvents these difficulties by solving a two-point (boundary) problem with fixed specified coordinates of the source and observer, instead of the traditional formulation as a Cauchy problem. The ionospheric layer is specified in the form of a parabolic layer with slowly changing parameters and an equation is derived for the critical angle in the horizontally inhomogeneous layer. It is found that for the continuously inhomogeneous F layer, the perturbation procedure is inapplicable only for trajectories having sections within the layer longer than a few thousand kilometers. The considerable divergence of such rays leads to a large field attenuation and thus these rays are of little practical importance, with the exception of ionospheric waveguide cases. Other than these cases, the results obtained attest to the possibility of applying the present technique to the description of grazing (quasi-critical) rays in a horizontally inhomogeneous ionosphere. Figure 1; references: 13 Russian. [245-8225]

UDC 621.371.25

THE INFLUENCE OF AN ARTIFICIALLY PERTURBED REGION OF THE IONOSPHERE ON THE AMPLITUDE OF SHORTWAVE BAND SIGNALS

Gor'kiy IZV. VUZ: RADIOFIZIKA in Russian Vol 23, No 4, 1980 pp 502-504 manuscript received 24 Jul 79

BENEDIKTOV, Ye. A., GOROKHOV, N. A., IGNAT'YEV, Yu. A., MATYUGIN, S. N. and MITIKHIN, Yu. V., Radiophysics Scientific-Research Institute

[Abstract] High-power shortwave radio emissions can produce intense heating of the ionospheric plasma in the F-layer, which results in the formation of a perturbation region with vertical dimensions on the order of 10s of kilometers and horizontal dimensions determined by the transmitting antenna pattern. This paper presents results of measurements of the amplitudes of shortwave signals on a single skip, middle latitude path about 3,000 km long running through the edge of a perturbation region. The transmitter had an equivalent power of about 20 MW and was located near Gor'kiy; it produced vertical heating of the ionosphere using frequencies of 4.6 and 5.75 MHz. An unmodulated signal was transmitted in two modes: 1) Five minutes of operation with a five minute pause; and 2) 10 minutes on with a 10 minute pause. A test transmitter transmitted pulsed signals at a frequency close to 20 MHz in the direction of the perturbed region. The experiment was performed during 10 days in March--April of 1978 in the morning and during the day. Graphs are drawn which illustrate the factors governing the attenuation of the test signal; an analytical expression is adduced for the attenuation/gain of the test signal at the reception point which is caused by the focusing effect of the perturbed region. This transmission factor fell in a range of 0.84 to 0.92 from the theoretical calculations, factors which are noted as being close to the experimental values. The authors are grateful to G. G. Getmantsev for helpful discussion. Figures 2; references: 6 Russian. [245-8225]

STABLE ALGORITHM FOR IDENTIFICATION OF DIFFERENCE MODELS OF SIGNALS AND SYSTEMS

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 7, Jul 79 pp 77-80 manuscript received 13 Apr 79

ANDRIYANOV, A. V.

[Abstract] In problems involving the identification of objects and presentation of signals, it is important to find the parameters of the auto-regression model of the slipping mean. A new method is suggested for this solution, which is stable with respect to time shifts. The algorithm is based on the assumption that the input signal is a single pulse, time matched with the first point of the reading of the output signal. An example of identification of the parameters of a model with various initial points taken as the beginning of appearance of the signal is presented in order to illustrate the algorithm. This algorithm can be used as the basis for a method of identification of systems by their fixed input and output signals. The algorithm suggested for identification of objects by their input and output signals avoids the difficulties related to determination of the mutual placement of signals encountered in other methods. Figures 2; table 1; references 6: 3 Russian, 3 Western.

[309-6508]

INTERPOLATION AND RESTORATION OF SIGNALS USING EXTENDED SPLINES

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 7, Jul 79 pp 69-74 manuscript received 27 Nov 79

VRBA, Radimir, Department of Theoretical and Experimental Electrotechnology, Polytechnical Institute (Vysoké Učení Technické), Brno, CSSR

[Abstract] The use of cubic splines in interpolation is a compromise between interpolation quality and the required volume of computation. A cubic spline is defined on the basis of the general definition of the smooth piecewise-polynomial functions known as splines. A new type of spline, called the extended spline, is introduced; this new spline can be calculated without knowing all of the fixed points in a series of measurements representing a signal or process. Some of the most important types of restoring interpolators and generators based on the use of ordinary cubic and extended splines are studied. Extended cubic splines are a modification of ordinary cubic splines, but do not guarantee continuity of the second derivative. Figures 6; references 5: 1 Russian, 2 Eastern European, 2 Western.

[309-6508]

POSSIBILITY OF USING A SYSTEM OF PARTIAL ADAPTIVE DETECTION ALGORITHMS

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 7, Jul 79 pp 15-20 manuscript received 6 Jul 78; after revision 7 Jan 80

MAZOR, Yu. L. and CHACHKOVSKIY, S. V.

[Abstract] An adaptive optimal detector is an optimal receiver, achieving the Bayes estimate of the likelihood ratio of the probability of proper detection of the optimal receiver by an adaptive optimal algorithm. It has been shown that for the adaptation problem to be effectively solved, it must be assumed that the uncertainty is concentrated in a relatively small number of parameters. This article analyzes the possibility that this condition will be fulfilled. The analysis shows that the system of particular processing algorithms includes parallel-series adaptation in place of the universal series adaptation procedure, achieved by selection of particular coefficients of adjustable algorithms, thus achieving a gain in interference stability in comparison with the adaptive optimal detector when learning time is severely limited. In the model studied, the particular processing algorithms operate in parallel, each being adjustable in a small number of parameters. Figures 2; references: 3 Russian.
[309-6508]

EVALUATING THE EFFICACY OF RADIO RELAY SYSTEMS ON THE BASIS OF A COMPOSITE CRITERION

Moscow ELEKTROSVYAZ' in Russian No 6, Jun 80 pp 34-38 manuscript received 4 Oct 79

VINOGRADOV, N. V.

[Abstract] A composite criterion is established for calculating the efficacy of radio relay systems with respect to electromagnetic compatibility. The criterion involves the utilization factor, proportional to the transmission capacity referred to the rate of binary data transmission, and three load factors generalized over the frequency-space domain. Calculation of the efficacy is based on a comparison of relative values characterizing various radio relay systems. Each factor in the composite criterion is expressed in terms of relevant design and performance parameters, in appropriate units and referred to a hypothetical 2500 km long standard line, including frequency deviation, noise power, and interference power, number of stations, and distance between stations. Numerical results obtained for five different types of radio relay systems reveal both best and worst ones with respect to electromagnetic compatibility. They also reveal that the efficacy of a radio

relay system increases proportionally to the square root of the signal bandwidth, never reaching the optimum regardless of this and other design parameters, and decreases fast down to failure levels with increasing frequency instability of the discrete interference components. The author thanks S. V. BORODICH for help and suggestions, as well as D. V. MERMEL'SHTEYN for many comments which have contributed to improving this presentation. Figures 2; table 1; references: 5 Russian. [16-2415]

UDC 621.391.13

DISTRIBUTIONS OF SIGNAL LEVELS IN SHORTWAVE RADIO COMMUNICATION LINES

Moscow ELEKTROSVYAZ' in Russian No 6, Jun 80 pp 43-46 manuscript received 2 Jul 79

KHMEI'NITSKIY, Ye. A.

[Abstract] Fadeout in shortwave radio communication lines transmitting at the carrier frequency is caused by interference of two signals and can be so deep as to pose serious problems. Here the causes of interference fadeout are examined on the basis of probable trajectories and behavior of radio waves in the ionosphere, with the possibility of a Doppler effect. The amplitude distributions of signals produced by two radio beams are calculated accordingly, as is the amplitude distribution of their sum. The results of calculation are compared with experimental data. On this basis, in turn, the conditions are established where either overall or selective interference fadeout will occur, as well as the dependence under these conditions of the error probability on the signal-to-interference ratio in the case of a Rayleigh distribution of interference levels. Addition of appreciable margins to the signal-to-interference ratio is recommended, depending on the length of the communication line and the length of its continuous operation, in order to ensure the necessary reliability. Figures 6; references: 5 Russian. [16-2415]

INTERMEDIATE STATIONS WITH CONTAINERIZED R-600-2MV EQUIPMENT: EXPERIENCE IN OPERATING THE BARNAUL-BIYSK RADIO RELAY LINE

Moscow ELEKTROSVYAZ' in Russian No 7, Jul 80 pp 18-19 manuscript received 13 Jun 79

KERIMOV, G. A.

[Abstract] Constructing and equipping the intermediate stations is the most costly and time consuming item in the installation of radio relay lines, inasmuch as these stations must usually be built far away from industrial sites and supply bases. Containerization of equipment has made it possible to put the Barnaul-Biysk radio relay line in operation 1 year ahead of schedule. A container here consists of an enclosure comprising an outer sheath of perforated 1 mm thick steel strip and an inner sheath of asbestos sheet with glass wool in between, on a $7.5 \times 3.25 \text{ m}^2$ large floor over a pad of reinforced concrete. Heaters are included inside for the winter: eight 1-kW units in the operating apparatus compartment, six 1-kW units in the power-supply compartment, and eight 1-kW units in the Diesel engine compartment. The performance of these thus equipped stations was monitored throughout January and February 1979, when the ambient air temperature varied between -5 and -45°C . It has been found necessary to continue improving the reliability of automatic controls, to add another standby feeder, to improve the hermetization, to add shielding against solar radiation, and to make various other modifications. Figures 3.

[10-2415]

ADVANCED METHODS OF CONSTRUCTING RADIO RELAY LINES

Moscow VESTNIK SVYAZI in Russian No 7, Jul 80 pp 6-8

CHERNYY, E. L., chief engineer, Construction Management of No 1 Project, USSR Ministry of Communications, meritorious constructor of the Russian Soviet Federated Socialist Republic, and DRAGILEV, Ye. D., chief project engineer, State All-Union Planning Institute, USSR Ministry of Communications; both USSR Council of Ministers Prize Laureates

[Abstract] Accomplishments of the tenth Five-Year Plan include construction of the Zheleznogorsk-Yakutsk radio relay line for both telephone communication and color television transmission. The line runs over almost inaccessible terrain including permafrost regions where the temperature reaches -56°C . The success of this project is due to implementation of some most advanced techniques such as the periscopic 2-frequency antenna design which features a high degree of interference immunity and results in a 2.4 times larger telephone channel capacity than originally planned at a lower cost of 2 million rubles. Foundation pads were laid with tubular metal grids or reinforced-concrete slabs with almost complete elimination

of "wet" processes. Aluminum panels with adequate thermomechanical characteristics were used for enclosures of Diesel-electric power plants. Up to 200 m tall antenna masts were erected, after horizontal preassembly of components on the ground, according to the method of "buildup by stitching" with the use of "creeping" cranes. Optimization of layout and routing based on preliminary aerial photography of the terrain has saved 840 m of supports or approximately 430 tons of high-alloy steel. Not the least contributor to the prize winning achievement was a high degree of standardization, which ensured a more labor and material efficient prefabrication and erection of structural components. The experience gained here is now used whenever possible in the planning of a radio relay line along the Baykal-Amur main railroad line. Figures 2.

[19-2415]

UDC 621.311.6:621.39

A DYNAMIC VOLTAGE STABILIZER FOR RECTIFIER EQUIPMENT

Moscow ELEKTROSVYAZ' in Russian No 7, Jul 80 pp 48-50 manuscript received 2 Aug 78

ALEKSANDROV, F. I.

[Abstract] A dynamic voltage stabilizer has been developed for improving the transient performance of electric power supplies and eliminating service interruptions in rural electromechanical automatic telephone networks of a capacity up to 200 subscribers. The device is built as a separate module and placed inside the automation and charging bay. It consists of two transistor regulator stages, one for stepping up and one for stepping down the voltage. Its transient performance is analyzed here on the basis of an equivalent capacitor and found to be analogous to that of a class C active filter for interference suppression. The insensitivity zone of its input signal must be optimized so as to provide the best tradeoff between load capacity and voltage stability requirements. The device is rated for 900 W and 15 A, designed for voltages ± 60 V, and delivers $56 \pm 10\%$ V without voltage overshoot after a short circuit. Figures 3; references 6: 5 Russian, 1 Western.

[10-2415]

INTERFERENCE STABILITY OF AN ANALOG-DIGITAL SYNCHRONOUS-PHASE DEMODULATOR FOR SIGNALS WITH ANGULAR MODULATION

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 7, Jul 79 pp 10-14 manuscript received 4 May 79; after revision 5 Nov 75

FOMIN, A. P. and KHOROSHAVIN, A. I.

[Abstract] Results are presented from studies of the interference stability of an analog-digital synchronous-phase demodulator in which the output signal of the phase discriminator is transformed to digital form by an analog-digital converter, and then, after filtration in a linear digital filter, is restored to analog form by a digital-analog converter. The methods of statistical linearization are used to study the device in the linear approximation. The conditions under which the duration of the transient process is minimal are determined and found to be a particular case of the conditions of maximum signal phase tracking accuracy. Under certain conditions, the quasi-optimal device studied is equal in interference stability to its analog prototype. Figures 2; references: 5 Russian.
[309-6508]

DETECTION OF INDIVIDUAL PULSES BY THE CONTRAST METHOD

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 7, Jul 79 pp 80-81 manuscript received 16 Apr 79

ZIKIY, A. N.

[Abstract] A study based on the contrast method is made of an algorithm for detection of pulsed radio signals with imprecisely known carrier frequency. This method calls for the production of two statistically independent samples from the envelope of the process studied at the output of a typical channel: bandpass filter--detector--video filter; a reference noise sample and the sample to be analyzed. The decision rule has the important property that the probability of a false alarm is independent of the dispersion of the noise. Computer calculation indicates that when the noise increases by a factor of 100, the probability of a false alarm increases by a factor of only 3.7. Figure 1; table 1; references 2: 1 Russian, 1 Western.
[309-6508]

ESTIMATING THE SENSITIVITY OF A MICROWAVE RECEIVER WITH A TRAVELING-WAVE TUBE AT THE INPUT UNDER CONDITIONS OF INTERFERENCE

Moscow ELEKTROSVYAZ' in Russian No 7, Jul 80 pp 16-17 manuscript received 31 May 79

ALGAZINOV, E. K. and BOBRESHOV, A. M.

[Abstract] A microwave receiver is considered with a traveling-wave tube amplifier subject to interference as the input stage. Its sensitivity in terms of useful and intrinsic noise power, or signal-to-noise ratio, at the output is calculated taking into account not only the interference level but also the nonlinearity of the amplifier gain characteristic. The simple formula, supported by experimental data, is suitable for estimating the receiver performance in problems of electromagnetic compatibility. Figures 3; references: 1 Russian.
[10-2415]

NEW P4110 HIGH-VOLTAGE CABLE INSTRUMENT

Moscow VESTNIK SVYAZI in Russian No 6, Jun 80 pp 25-27

SIUKAYEV, A. V., leader of theme, development of cable devices, "Megommetr" Plant, candidate of technical sciences

[Abstract] This year the Umanskiy "Megommetr" [megohmmeter] Plant began series production of a complex of high-voltage cable instruments used in a search for the location of a reduced strength of insulation (MPPI), in which electrical breakdowns take place during operation. The complex, which was developed by specialists of the Umanskiy plant and the Kiev Branch of the TsNIIS (Central Scientific-Research Institute of Communications), has a number of advantages over the available non-standard devices produced in small batches by the assembly control of the "Mezhgorsvyaz'stroy" (All-Union State Trust for the Construction of Long-Distance Wire Communications Structures). A block diagram, the principal circuits of the individual units, technical data on the P4110 and a photograph of the instrument are presented. The P4110 is widely used in all stages of production, construction and exploitation of balanced and coaxial, underground and underwater (marine) communication cables. According to preliminary computations, the annual economic effect from the entry into the national economy of the P4110 in a complex with the R41270 high-voltage cable bridge amounts to 250 thousand rubles. Figures 5.
[320-6415]

STANDARDIZATION OF SWITCHING EQUIPMENT AS THE BASIS FOR AUTOMATED WIRING AND TUNING OPERATIONS

Moscow ELEKTROSVYAZ' in Russian No 7, Jul 80 pp 30-31 manuscript received 7 Aug 79

ALYAPKIN, V. D. and OVSYANNIKOV, A. I.

[Abstract] Various items in the standardization of switching equipment provide a basis for automation of wiring and tuning operations. Here are considered pin boards, one particular such item, namely dimensions and spacing of pins on boards of various shapes and sizes. Data and drawings are shown of different pins and boards produced in two Soviet manufacturing plants (VEF and "Krasnaya Zarya"), in Czechoslovakia ("Tesla Kolin" plant), in the German Democratic Republic (RFT), and the same pin and board produced in Sweden ("Ericson" plant) and in Yugoslavia ("Nikola Tesla" plant). The adverse consequences of diversity on the tools and the process are discussed. The need for standardization is emphasized and the technological implications as well as the effect on labor are accounted for. Tables 2; references: 2 Russian.
[10-2415]

IMPROVEMENT OF THE ATSK-U CROSSBAR AUTOMATIC TELEPHONE SYSTEM

Moscow ELEKTROSVYAZ' in Russian No 7, Jul 80 pp 20-25 manuscript received 25 Sep 78

VASIL'YEVA, L. S. and MOVSHOVICH, I. Kh.

[Abstract] ATSK-U equipment for crossbar automatic telephone systems has been series produced since early 1979. It includes subscriber, group, and register stages with connections established through markers by the indirect method. A subscriber set includes one small electromagnetic signal relay and one "Molybdenum" sealed-contact relay. Other components of the ATSK-U equipment include dialing sets for senders and receivers, a frequency switching board, and a code-type receiver with time delay and automatic level regulation. The interference immunity of the code for transmission of frequency data from register to markers has been improved, relay-type pulse transmitters have been replaced by electronic ones and other relays will be, the circuit of subscriber registers has been simplified, new pulse generators have been developed for rural and special service, the capacitive bridge of the supply circuit in cord sets has been replaced with a transformer bridge for better symmetrization with fewer components. The performance of all equipment is checked by more effective means of inspection, which includes an electronically controlled automatic typewriter. The system checking and testing equipment has also been improved and the load is metered electronically. A higher

reliability and a longer life of equipment remain to be the goals of further developments in urban crossbar automatic telephone systems. Figures 4; references: 6 Russian.

[10-2415]

UDC 621.395.341

CHECKING THE PULSE CIRCUITS IN EQUIPMENT OF AUTOMATIC TELEPHONE NETWORKS

Moscow ELEKTROSVYAZ' in Russian No 7, Jul 80 pp 26-29 manuscript received 25 Oct 77

MELAMUD, E. A. and SHAPIRO, S. B.

[Abstract] All equipment in automatic telephone networks falls into two classes according to the performance requirements for operation with dialing pulses: devices designed for a pulse rate of 9-11 pulses/s with a 1.3-1.9 pulse factor and devices designed for a pulse rate of 7-13 pulses/s with a 1.6-1.66 pulse factor. Checking the pulse circuits in any of this equipment under service conditions is based on tolerance limits which will accept marginal but still reliable ones and reject marginal but already unreliable ones. For each class, accordingly, a tolerance quadrilateral has been drawn in the plane of coordinates with the (current) pulse duration along the x-axis and the pause duration along the y-axis. This graph has been plotted so as to allow correcting for differences in distance and pulse repetition rate as well as for systematic distortions and deviations. In the design of new devices it is recommended that the range of variability be narrowed distortions in the dialing set due to terminal equipment be minimized. In order to define the tolerance region (quadrilateral) not two but four extreme acceptable values of the parameters must be stipulated: not the minimum and the maximum pulse rates with one pulse factor, but each of these pulse rates with the minimum and the maximum pulse factors. Figures 2; tables 3; references: 4 Russian.

[10-2415]

EVOLUTION OF ELECTRONIC SWITCHING SYSTEMS AND PROBLEMS IN THE DESIGN OF ANALOG-DIGITAL TELEPHONE NETWORKS

Moscow ELEKTROSVYAZ' in Russian No 6, Jun 80 pp 24-28 manuscript received 27 Mar 79

SHTAGER, V. V.

[Abstract] The development of electronic automated telephone networks at the Leningrad Branch of the Scientific-Research Institute of Communications began in 1960 by applying the principle of pulse-time division of channels to a small 100-subscriber system, using capacitive memories for maintenance of connections and diode switches in the speech channels with pulse-amplitude modulation and resonant energy transmission. Experimental large electronic automated telephone networks have subsequently been built with the participation of other CEMA countries, particularly the GDR, the first one in the 1963-68 period and the second one in the 1969-73 period. The latter was designed to operate on the basis of pulse-code modulation and to be built with transistor-transistor-logic circuit integration. Further developments since then have focused on electronic switching systems for tandem stations. They are now designed without or almost without hold-up, with alternating time division and space division stages, using MOS memories, and tending toward broader large-scale circuit integration. They feature control through high-speed computers with decentralization of the lower (peripheral) level, signalization in accordance with CCITT recommendations, and "subordinated" synchronization of concentrators by means of reference generators. Problems of hybrid analog-digital communication systems arise in the utilization of existing networks. Three methods of changeover to electronic switching are considered: 1) Installation of a completely independent and isolated one at all levels (including the interurban level), 2) Installation of an isolated local digital on in base-tandem and tandem stations coupled through pulse-code-modulation channels to existing networks; and 3) Random replacement of any operating station with an electronic one without simultaneous installation of digital transmission systems. A comparative evaluation indicates that the second method is the most preferable, despite some design limitations and the lack of pertinent standards or recommendations (CCITT Q-45 applies to analog equipment and can only temporarily, though incorrectly, be applied to analog-digital equipment). Figures 4; references 4: 3 Russian, 1 East German.

[16-2415]

IMPROVING THE TECHNICAL SERVICE OF THE MOSCOW URBAN TELEPHONE NETWORK

Moscow ELEKTROSVYAZ' in Russian No 6, Jun 80 pp 29-33

VASIL'YEV, V. F. and SAGALOVICH, L. I.

[Abstract] Over the almost 100 years of service, the Moscow Urban Telephone Network has acquired a great diversity of equipment. At this time the labor productivity in operating the network is being improved by various means which aim at centralization of the technical service and at automation of individual operations. An important role is played here by a highly skilled staff which every year draws from a pool of 500-530 graduates of academic-technical schools and 430-440 graduates of trade-technical schools. A central repair and overhaul office has been established which supervises all aspects of technical service such as installation of new equipment for automatic testing and inspection, cable splicing, and reliable data transmission. Installation of an automatic system of control of technological processes has begun in 1978 and proceeds at several functional levels, namely automation of discrete operational control as well as automation of quality and efficiency control. Personnel is aided by equipment, the equipment necessary including KONTROL for data gathering, KROSSO for data recording and status indication, ASKPU for line continuity checking, and a PPT-400 panel. The dispatcher's office is still the main component in the technical service system, as well as in a centralized one, now using Unified System general-purpose computers as well as small process-control computers with an administrative-technical telephone network. Figures 5.

[16-2415]

SEQUENTIAL PROCEDURE FOR DETECTION OF A SIGNAL AGAINST A BACKGROUND OF GAUSSIAN NOISE WITH UNKNOWN CORRELATION PROPERTIES

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 7, Jul 79 pp 83-85 manuscript received 14 May 79; after revision 23 Jul 79

SHLOMA, A. M. and GOL'FEL'D, G. B.

[Abstract] A method of overcoming the a priori uncertainty in multidimensional sequential analysis suggested in 1963 by D. R. Cox has the shortcoming that the probability of a false alarm is only asymptotically stabilized. The present article presents six sequential algorithms which do not have this shortcoming. References 4: 3 Russian, 1 Western.

[309-6508]

WAYS TO REDUCE SHUTDOWNS OF CABLE TRUNKLINE CHANNELS

Moscow VESTNIK SVYAZI in Russian No 7, Jul 80 pp 27-28

YARTSEV, G. Ye., senior trunkline engineer, GUMTS [Main Administration of Material and Equipment Supply], USSR Ministry of Communications

[Abstract] Shutdowns of the primary interurban telephone trunkline network had been reduced by 17.1% from 1978 to 1979, and their further reduction by 10% is planned for the current year. Essentially, such reductions are the result of fewer and shorter scheduled inspections as well as fewer failures. This requires the use of more reliable and better protected K-1920 and K-60P equipment, suitably pre-aged for high-voltage operation and designed for lower supply voltages. This is the responsibility of equipment manufacturers. The responsibility of network management is to better organize and program the training of personnel, especially in exchange offices and particularly the younger cadres whose technical education has not been thorough enough. Further improvement of reliability and reduction of shutdowns will also result from a more systematic analysis of failure conditions, and implementation of preventive measures on the basis of computerized and automated data processing.

[19-2415]

UDC 621.396.931

STATISTICAL CHARACTERISTICS OF RADIO INTERFERENCE WITHIN THE RANGE OF A MOBILE LAND RADIO STATION

Moscow ELEKTROSVYAZ' in Russian No 6, Jun 80 pp 46-50 manuscript received 1 Aug 79

MYASKOVSKIY, G. M. and KIRICHENKO, V. I.

[Abstract] Mobile land radio communication is undergoing a most intensive development in the Soviet Union as well as in other countries. Here the interference immunity of such systems within the range of the station is evaluated on the basis of a set of statistical characteristics. These include amplitude characteristics of pulses or pulse trains (probability distribution of their amplitudes), their space characteristics (dependence of their attenuation on the distance from interference source to receiver), their time characteristics (probability distributions of their appearance and cutoff times and of their durations), and their frequency characteristics (amplitude-frequency, time-frequency, and space-frequency within a certain frequency band). On the basis of these statistics the interference parameters of radiotelephone and discrete-data reception characteristic of city streets and highways are calculated. While the amplitude statistics do not change with time in response to automobile traffic intensity and topographical or structural features of automobile arteries, the time statistics are closely correlated with the traffic flow parameters, especially in heavy traffic. Figures 3; table 1; references: 5 Russian.

[16-2415]

A DATA GATHERING AND PROCESSING SYSTEM WITH THE USE OF PRIMARY MACHINES

Moscow ELEKTROSVYAZ' in Russian No 7, Jul 80 pp 36-40 manuscript received 4 Apr 78

SKAKAL'SKIY, A. B.

[Abstract] An automatic system of data gathering and primary processing with the use of primary electronic monitoring and recording machines has been built for the purpose of organizing these and other attendant activities involved in cash and account management in enterprises of the communication industry. Here such a machine, the universal Iskra-362, is described with all its essential components and features which include the layout of documents. The structure of the entire system is also described, particularly the flow of punch tape and the flow of documents, as it would be used in the simple case of decentralized administration of enterprises in a republic not subdivided into oblasts. Figures 4; references: 7 Russian. [10-2415]

COMPONENTS AND CIRCUIT ELEMENTS,
WAVEGUIDES, CAVITY RESONATORS AND FILTERS

UDC 621.372.413

ON A MICROWAVE RESONATOR METHOD OF STUDYING A SOLID-STATE PLASMA

Gor'kiy IZV. VUZ: RADIOFIZIKA in Russian Vol 23, No 4, 1980 pp 407-418 manuscript received 20 Mar 79

MILYAYEV, V. A. and SANINA, V. A., Physics Institute imeni P. N. Lebedev, USSR Academy of Sciences

[Abstract] Microwave resonator circuits are superior to waveguide configurations for experimental studies of a solid-state plasma, because of their higher sensitivity and the capability of producing a greater microwave field intensity inside a sample in the resonator for a given generator power. This paper studies the response of a microwave resonator to a sample occupying a portion of its volume. This response to the excitation of nonequilibrium carriers in the sample of the semiconductor inside the resonator is a complex function of the concentration of free carriers, N , and consists in a change in the Q of the resonator and its resonant frequency. An explicit form is derived for this function for the case of a sample which is much smaller than the resonator. This limitation made it possible to solve the problem in a wide range of N . The resonator response also depends substantially on where the sample is positioned: at a maximum of the electrical or magnetic component of the microwave field in the resonator. In the first case, the resonator response when $N = N_0$ has characteristic features related to the fact that the plasma frequency of the system of electrons and holes is equal to the klystron frequency. The effect of plasma resonance is manifest at the temperatures of liquid helium. Knowing the theoretical value of the absorption signal and the detuning of the resonator as a function of concentration of carriers, one can establish the true kinetics of the carriers in the sample, for example, after they have been excited with a laser pulse, i.e., their absolute concentration can be determined for any point in time. When the sample is positioned at a maximum of the magnetic field, assuming no skin effect, the change in the Q and the detuning of the resonator are linearly related to N . These two latter factors are calculated by way of example for samples of Ge containing small and large electron-hole droplets. The analysis of the sample positions at maxima of the electrical and magnetic fields also considers homogeneous and inhomogeneous distributions of the fields within the samples. The conditions governing the linearity in the reproduction of the absorption and detuning signals by a radio spectrometer with a reflective resonator are given. An analytical expression is also derived for the form of an absorption "line," as well as the collision frequency. Figures 3; references 10: 8 Russian, 2 Western.
[245-8225]

THE DETERMINATION OF THE FIELDS OF STRIPLINES USING THE METHOD OF MINIMAL AUTONOMOUS BLOCKS

Gor'kiy IZV. VUZ: RADIOFIZIKA in Russian Vol 23, No 4, 1980 pp 486-494 manuscript received 10 Apr 79

LAVROVA, T. I. and NIKOL'SKIY, V. V., Moscow Institute of Radio Engineering, Electronics and Automation

[Abstract] A method of minimal autonomous blocks (MAB) was proposed earlier by the authors ("Mashinnoye Proyektirovaniye Ustroystv i Sistem SVCh," MIREA Publishers, 1978) for the analysis of the resonant modes of both regular longitudinal, and periodic guide systems. This paper extends the MAB technique to the determination of the fields of striplines on a ferrite or dielectric substrate. The essence of MAB analysis is the subdivision of the stripline structure into elemental cells of a matrix (in the case considered here, a 12th order matrix broken down into cells [blocks], which constitute the layer of perpendicular channels and external longitudinal channels). The matrix analysis of the block structure is used in order to determine the field in the stripline cross-section, where lines on an isotropic dielectric substrate, as well as on a ferrite substrate were magnetically biased in three ways: 1) Transverse normal magnetization; 2) Transverse tangential; and 3) Longitudinal. The transverse electrical and magnetic fields are shown in tabular form as numerical values of the field vectors for each of the elemental blocks. A vector diagram which shows the primary mode field of the striplines is also presented. Figures 5; tables 5; references: 1 Russian. [245-8225]

AN ANALYSIS OF THE SWITCHING NOISE OF SWITCHABLE FILTERS

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 4, Apr 80 pp 91-93 manuscript received 28 Mar 79; after revision, 15 Jun 79

CHERYUKANOV, A. S.

[Abstract] A switchable filter is represented as a structure of n identical parallel channels, with each channel containing a filter with a known transfer function, where the filter is connected in series with the input and output of the structure by means of a controlled switcher. The presence of the switcher leads to the appearance of a comparatively high noise level at the output, running up to a few tens of millivolts, something which considerably narrows the dynamic range of the switchable filter. The major causes of the switching noise are the scatter in the parameters of the switcher components from channel to channel, the nonideal nature

of the switching circuits and the presence of parasitic reactive components in the filter and switcher circuits. The noise takes the form of residual switching potentials: rectangular and triangular waveform pulses from the leading edges of the switching pulses of the switcher. Analytical expressions are derived for the average value of the overall noise voltage of all filter channels and the amplitudes of the parasitic sawtooth and square wave pulses. An experimental check of the derived relationships shows that the calculated values of the noise amplitude, regardless of the type of switcher, exceed the actual values by no more than 10 to 15%. The possible amplitude of switchable filter noise can be determined from the statistical characteristics of the parasitic pulses of the switcher. References: 2 Russian.
[258-8225]

UDC 621.391.1

AN ANALYSIS OF THE CORRELATION DISTORTION OF A SIGNAL IN A NONGAUSSIAN WHITENING FILTER

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 4, Apr 80 pp 51-55 manuscript received 6 Mar 79; after revision, 18 Jun 79

AVDEYEV, V. V. and PARSHIN, Yu. N.

[Abstract] In the case of optimal signal processing against a background of arbitrary interference, the resolution and time delay measurement capabilities are determined by the signal component of the logarithm of the likelihood ratio, which in the general case does not match the autocorrelation function of the signal, something which attests to the presence of correlation distortion. This distortion is analyzed where the signal is detected in nongaussian interference and white noise; the algorithm for computing the logarithm of the likelihood ratio is predicated on the use of a whitening filter. It is shown that the signal component of this logarithm takes the form of a cross-correlation function between the signal component from the filter output and a reference signal. Because the whitening filter is a nonlinear device, the signal component is random and is treated statistically. The general expression derived for this cross-correlation function is applied to the special case of sinusoidal interference and the relevant analytical expression for the signal component is found. Another method of correlation distortion analysis is based on interference compensation in a correcting filter. The results of calculating the signal component for a linear FM pulse weighted with a Hamming function are shown graphically as the signal power at the whitening filter output as a function of the spectral power density of the interference and the correlation interval between the interference and the signal. Calculations show that the change in the signal energy for any interference parameters does not exceed 3 dB, which is evidence of the high efficiency of the nonlinear whitening filter. At the same time, the level of the side lobes of the average value of the signal component can rise by 20 dB, which is impermissible in a number of cases. The

proposed procedure makes it possible on one hand to estimate the correlation distortions for optimal processing of a long signal against a background of high power nongaussian interference and gaussian white noise, and on the other, provides recommendations for the synthesis of a correcting filter or a reference signal to compensate for these distortions. Figures 2; references: 5 Russian. [258-8225]

UDC 621.391.2

THE SYNTHESIS OF A BINARY PERIODIC SIGNAL AND FILTER PAIR

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 4, Apr 80 pp 56-61 manuscript received 22 Mar 79; after revision 3 Jul 79

IPATOV, V. P.

[Abstract] Although it has been demonstrated that a filter can be designed for any periodic discrete signal with linearly independent cyclical shifts, which suppresses all sidelobes on the delay axis of the time-frequency plane down to zero, the regular rules given in the literature for the construction of optimum binary periodic sequences with negligible losses in such filters generate a relatively small number of sequences in the range of practical interest. This paper presents the results of computer searches for binary sequences having N elements, either 0 or 1, with minimum possible losses. An algorithm is also described which makes it possible to build new sequences on these, where the new sequences have interesting properties and large values of N ($N > 30$). A useful expression is derived for the lower bound of the losses in a proposed sidelobe suppression filter, and the lack of promise for the use of well-known minimax binary periodic sequences in radio channels containing such filters at the receive end is demonstrated. The relative loss of such filters in dB is presented tabular form for values of N from 3 to 30. A YeS-1033 computer was used to find the globally optimal sequences where $N < 30$. The tabulated results of the computer sorting show that when N is 19 or less, almost all of the optimum sequences have insignificant losses for the case of sidelobe suppression filter processing. The procedure given to combine small sequences for the generation of longer ones, as well as the expressions for the losses and the weighting coefficients are easily generalized for the case of an arbitrary number of elements with pair-by-pair mutually prime lengths. Table 1; references 10: 9 Russian, 1 Western. [258-8225]

THE LIKELIHOOD FUNCTION IN TRAJECTORY DISCRIMINATION PROBLEMS

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 4, Apr 80 pp 67-71 manuscript received 2 Apr 79

KOVAL'CHUK, I. A.

[Abstract] A distinctive feature of secondary processing problems is the existence of ambiguity in measurements caused by the tracking of several signals intruding into the strobe, which can be caused by false alarms and other objects. This ambiguity can be circumvented by determining the likelihood function of combinations of measurements over a definite number of scans and selecting that set which optimizes the likelihood function. A form of the likelihood function is derived which solves the problem of trajectory recognition by means of a fixed number of tracking filters, where previous methods in the literature require an increasing number of filters. The recognition problem or the selection of the trajectory branch corresponding to the useful signals is treated as a problem in multiple alternative decision making which, in the case of identical a priori probabilities for the branches and identical losses from any incorrect decision, reduces to the selection of that trajectory branch which maximizes the combined probability density of the measurements. The likelihood function derived here for trajectory recognition simplifies the construction of the secondary processing algorithm when tracking an object in a noise environment; the determination of the quantitative impact of the memory parameter on the algorithm efficiency is a subject for further research. References 6: 3 Russian, 3 Western (1 in translation). [258-8225]

THE OPTIMIZATION OF COHERENT WEIGHTED STORAGE DEVICES

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 4, Apr 80 pp 46-50 manuscript received 17 Jul 78; after revision 11 Jun 79

LIFANOV, Ye. I. and SEREBRYAKOV, V. P.

[Abstract] The signal processing involved in the detection of a coherent signal with periodic modulation against a background of correlated noise and interference can be broken down into the intraperiod and interperiod processing. Interperiod processors are frequently coherent weighted storage filters which unfortunately do not realize their potential in the case of various pulse functions. This paper analyzes and solves the problem of optimizing a coherent weighted storage filter under conditions of a priori parametric indeterminacy using a criterion close to

that of a minimum of the averaged mean risk. It is assumed that the input signal is a random additive mixture of gaussian processes; analytical expressions are derived for measures of filter optimality in two cases: where the distribution function of the signal and interference are known, and are a priori unknowns. The solution of the optimization problem is illustrated for these two cases with numerically modeled curves for the subnoise visibility ratio expressed in dB as a function of the normalized difference between the doppler phase shifts of the signal and interference. Optimal absolute values of the weighting coefficients are present in tabular form for the model case. The proposed approach is suggested as a decision making criterion in evaluating the effectiveness of possible adaptive filter designs and it is noted that the coherent weighted storage filters synthesized for the two cases are considerably more efficient than those treated by A. A. Babanov, et al. [RADIOELEKTRONIKA, Vol 19, No 4, 1976] which have the same structure. Figures 2; table 1; references 7: 5 Russian, 2 Western (1 in translation). [258-8225]

UDC 621.396.66

AN ANALYSIS OF THE FREQUENCY PROPERTIES OF SWITCHED REJECTION FILTERS

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 4, Apr 80 pp 72-77 manuscript received 9 Oct 78; after revision 10 Jul 79

MEDVEDIK, A. D.

[Abstract] High operational speed in tuning rejection filters can be achieved by using switched filters based on several partial channels with identical frequency responses, which produce the requisite frequency characteristics when combined. This paper analyzes the influence of the amplitude-frequency response of the partial channels on the shape of the overall response of switched rejection filters for interperiod processing. Upper estimates are derived for the nonuniformity of the response in the transmittance range and the suppression in the rejection range. The filters are designed to segregate an unmodulated signal packet from a background of white noise and correlated interference with an arbitrary doppler shift. The conditions governing the choice of the overall number of partial channels which cover the possible range of target velocities are analyzed to produce expressions defining the filter response. These expressions are illustrated numerically using the example of the amplitude-frequency response plotted for the filters when bursts of from 5 to 50 pulses are processed. The response is also shown graphically for three different weighting functions: 1) A Hamming function; 2) Dolf-Chebyshev; and 3) Square-law. The graphs show responses with both single and multiple rejection lands. Figures 5; references 4: 3 Russian, 1 Western. [258-8225]

AN EVALUATION OF THE INFLUENCE OF MEMORY ERRORS IN DIGITAL-ANALOG TRANSVERSE FILTERS

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 4, Apr 80 pp 95-98 manuscript received 19 Apr 79; after revision, 20 Jun 79

SHUBS, Yu. V.

[Abstract] Digital-analog and hybrid transverse filters have found wide applications in real time signal processing. The delay operators for the digitization cycle are realized in these filters with digital-analog memories consisting of L series connected independent store locations, where L is the order of the filter, and the memory is accessed by rewriting the samples of the signal being processed in the memory store locations. The random scatter in the transmission factors of the store locations, i.e., the nonuniform rewriting of the signal samples, can substantially distort the frequency response of the synthesized filter and reduce the value of the processing. This paper analyzes the impact of these memory errors on the precision of the reproduction of specified frequency responses in transverse filters. Equations are derived which are used to illustrate filter response graphically: the level of the relative amplitude-frequency response distortion is plotted as a function of the order of the transverse filter for various values of memory errors. The synthesis of such filters with pulse characteristics having a length L of more than 128 and a response linearity commensurate with the approximation error requires a considerable increase in the precision of the memory components. The impact of memory errors can be reduced by curtailing the number of sequential rewrites (shifts) in the store locations; it is expedient in these cases to use combination type digital-analog memories, and an expression for the response distortions of such a combination memory based filter. The derived expressions make it possible to estimate the amplitude-frequency distortions for the case of a specified transverse filter order and precision of the store location components, and can serve as a convenient criterion for the optimum design of signal processors using such memories. Figures 2; references 3: 2 Russian, 1 Western.

[258-8225]

DYNAMIC CONTROL OF THE CONVERGENCE OF AN ADAPTIVE FILTER WHICH MINIMIZES THE MEAN SQUARE ERROR

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 4, Apr 80 pp 101-103 manuscript received 3 May 79; after revision, 29 Jun 79

BELINSKIY, V. T., KONSTANTINOVSKIY, A. G. and KUDINOV, A. V.

[Abstract] The maximum convergence rate in adaptive filters utilizing the criterion of a minimum mean square error is governed by the a priori data on the maximum power of the input process. This paper treats the possibility of controlling the convergence parameter of such filters during the adaptation process. The mathematical analysis of filter convergence is based on the following assumptions: the process at the input is Gaussian and steady state with a zero mean value; the readouts of the process at each of the digital filter taps produce a vector with each iteration, where these vectors are statistically independent for the different iterations. A control algorithm is found which provides for dynamic tracking of the input process power and the appropriate iteration by iteration selection of the convergence parameter. Although the limitations concerning the statistical independence of the outputs of the filter taps substantially facilitate the analysis, they do not impede the practical realization of an adaptive filter based on the proposed algorithm. This is confirmed although not discussed in detail in this paper by the computer modeling of the algorithm in which the parameters of the adaptive procedure proposed here proved to be close to those for a known effective algorithm. It is noted that dynamic control of filter convergence in the case of a powerwise steady-state input provides for a constant rate of convergence and constant relative adaptation error, which in turn allows for the minimization of the overall error. References: 6 Russian.
[258-8225]

THE DESIGN OF DIGITAL FILTERS FOR NONSTEADY-STATE RANDOM PROCESSES

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 4, Apr 80 pp 62-66 manuscript received 29 Apr 79; after revision 23 Jul 79

KRYLOV, V. V. and KORSAKOV, S. Ya.

[Abstract] A filter is designed in order to derive the estimate of a signal which is the realization of a centered nonsteady-state random process with a specified correlation function. The process is observed in an additive mixture of Gaussian white noise. It is assumed that the filter is realized as a dynamic,

timewise discrete system (a discrete Kalman filter). The analytical expressions derived to represent the filter are based on equations in the state space of the shaping filter, where the primary mathematical tools are the D-models proposed in the literature by V. V. Krylov [AVTOMATIKA I TELEMEXHANIKA, 1978, No 9 and 1979, No 5]. The matrices of the shaping filter are found in canonical form. Where it is usually assumed that the continuous signal is digitized by samples of the instantaneous values, here the discrete model of the signal sequence is not based on the instantaneous, but rather the average values in nonoverlapping digitization intervals. The transition from the continuous model to its discrete representation is shown by representing the process using a multiplicative orthogonal base. The realization of the optimal Kalman filter is presented in the form of a digital non-steady-state system with a finite pulse response. A filter design example for a specified correlation function is shown which has one input to an A/D converter, a clock input and a memory, with six memory outputs. The proposed procedure is an efficient tool for the design of such filters with several inputs and outputs. Figures 3; references 6: 4 Russian, 2 Western (1 in translation). [258-8225]

CONVERTERS, INVERTERS, TRANSDUCERS

UDC 621.372.8:621.374

TRANSDUCERS OF HIGH-LEVEL PULSE MICROWAVE POWER

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 6, Jun 80 p 61

YERSHOV, V. V., KATS, L. I. and KULAKOVSKIY, A. V.

[Abstract] The design is described of transducers of high-level pulse microwave power in which dependence of the resistance of a semiconductor with high mobility of the charge carriers on a microwave magnetic field is realized. Investigations of the transducers were conducted in rectangular waveguides of standard cross sections in the 3-10 cm band of wave lengths. Descriptions of three typical experimental dependences are presented. The transducers considered can be used during production and operation of power microwave devices, as well as in an automated control system of the technological process (ASU TP) of electrovacuum production. Figures 2. [315-6415]

UDC 681.3.087.92

HIGH-SPEED 12-DIGIT DIGITAL-ANALOG CURRENT CONVERTER

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 7, Jul 80 pp 56-58

BRACIN, A. A., KAPYSTYAN, A. N. and ORLOV, V. S.

[Abstract] At present digital-analog converters (DAC) are widely manufactured with summing up of discharge currents weighted according to the binary or binary-decimal law with use of active current dividers. In hybrid or integrated designs such DAC have a sufficiently high (0.1--1 microsec) speed of response. However, without special fitting of the elements, production of a DAC of more than 8-9 digits, with an error of the converter of 0.5--0.2% and a nonlinearity less than half the lowest order, is complicated. Limitations of precision and linearity are connected with a number of errors the principal part of which consists of error from current repeaters. The applicable methods for its decrease complicate engineering and often prove to be unacceptable for hybrid circuits. The present paper conducts a further investigation of circuits which can find use in integrated and hybrid DAC. The relative value is found of components of the error of the output current caused by influencing factors and by the initial spread of the circuit. During construction

of a DAC on the basis of shapers of discharge currents, it is possible to divide all the components of error into two groups: components which change the slope of the conversion characteristic, and components which determine the error of linearity of the DAC. The total error of the output current of the DAC is found and the principal circuit is described of a 12-digit high-speed digital-analog current converter constructed on the basis of a shaper of currents. Figures 2; tables 2; references: 4 Russian.
[13-6415]

UDC 621.317.7.001.6

AN INSTRUMENT FOR STUDY OF THE INSTABILITY OF INSTRUMENTAL ERROR OF ANALOG-DIGITAL CONVERTER

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 6, 1980 pp 25-26

KUTYRKIN, S. B., REGEDA, V. V. and TEMNOGRUDOV, A. V., engineers, SHLYKOV, G. P., candidate of technical sciences, and SHLYANDIN, V. M., doctor of technical sciences

[Abstract] A circuit realized in the IDP-2 instrument developed at the Penza Polytechnical Institute is described. The instrument is designed for measurement of the instability of the instrumental error of analog-digital converter of voltage and digital dc voltmeter. The output of the instrument is a recording on a strip chart, corresponding in shape and amplitude to the instability of the instrumental error of the ADC. This allows automatic recording of stability with a resolving capacity significantly greater than the quantization step of the ADC being studied. Figures 2; references: 2 Russian.
[306-6508]

SUPERCONDUCTING MICROWAVE RESONATORS AND THEIR USE IN METROLOGY

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 7, Jul 80 pp 28-29

PUDALOV, V. M.

[Abstract] It is clear that interest in the stabilization of the frequency of a generator by superconducting microwave resonators is caused by the prospects for wide use of such generators in metrology. As shown in the literature, generators stabilized by superconducting resonators (GSR) are free from the shortcomings of quantized frequency standards because they have a tunable operating frequency and an output power up to hundreds of milliwatts. The following areas of possible use of GSR in measuring techniques are discussed in the present paper: 1) GSR can be a secondary generator, tunable with respect to the frequency of quantum standards, and smoothing fluctuations of their frequency; 2) GSR can be used as stable sources with a tunable frequency during precision physical experiments in which high short-duration frequency stability is required; and 3) GSR operating in the 3-300 GHz range can serve as a source of fundamental frequency in the interval between the frequency of rubidium, cesium and hydrogen standards on the one hand and on the other the frequency of quantum generators stabilized with respect to the line of saturated molecular transitions. Parametric amplifiers hold promise for creation of GSR with a relative instability of frequency less than 10^{-16} . However, they are technically more complex than generators or amplifiers based on a tunnel diode. At present an operating design of a GSR based on a parametric amplifier has still not been produced, but according to a 1975 report the National Bureau of Standards, USA, is conducting investigations. Figures 1; references 11: 2 Russian, 9 Western. [13-6415]

ELECTRICAL ENGINEERING EQUIPMENT AND
MACHINERY: APPLICATIONS AND THEORY

UDC 621.313-181.48

SINE-COSINE ROTATABLE TRANSFORMER IN CURRENT REGIME

Novercherkassk IZV. VUZ: ELEKTROMEKHANIKA in Russian No 7, Jul 80 pp 752-755
manuscript received 4 May 78; after completion 1 Oct 79

BATOVIRIN, ALEKSANDRA ALEKSANDROVICH, candidate of technical sciences, professor,
Northwestern Correspondence Polytechnical Institute; and GUGEL'EV, VLADIMIR
MOISEYEVICH, engineer

[Abstract] Sine-cosine rotatable transformers (SCRT) are widely used in systems of automatic equipment. Ordinarily SCRT are supplied from a source of stable voltage and the magnitude of the load connected to the output winding considerably exceeds the output impedance of the SCRT. The present paper considers the operation of a SCRT in a current regime, in which power supply is realized from a source of stable current. Such a procedure makes it possible to realize a number of essentially new promising derivations. Thus, with a series connected primary winding of two induction linear noncontact potentiometers (in contrast to parallel), a change of the temperature of the environment for one of the units has no effect on the precision of operation of the circuit. Such a procedure also has advantages in the case of an extended electrical supply line with limited power. Figure 1; references: 2 Russian.

[316-6415]

UDC 621.316.925

DIFFERENTIAL PROTECTION ON CURRENT SENSORS WITH MAGNETIC-DIELECTRIC CORES

Minsk IZV. VUZ: ENERGETIKA in Russian No 6, Jun 80 pp 13-19 manuscript received 11 Feb 80

MIKHAYLOV, V. V., UL'YANITSKIY, Ye. M., candidates of technical sciences, dotsents, and PROUS, V. R., engineer

[Abstract] Because of the weight and size limitations of elements used for protection of vehicular power systems, normal current transformers with toroidal closed ferromagnetic cores are unsuitable. Bus-type sensors with cores made of magnetic dielectrics based on carbonyl iron powder have been developed for this purpose.

A current sensor using a magnetic dielectric core is distinguished by its low weight and small size, simplicity of manufacture of the core and good reproducibility of magnetic characteristics in mass production. In order to increase the sensitivity of these devices when they are used in the transreactor mode the delay is made dependent on current. Analysis of the input signals of differential relays is performed, assuming that the phases of the currents of the connections coincide, while the phase of the current of the damaged connection is 180° out of synch. The use of the maximum potential difference principle for delay is found to achieve differential protection equal in sensitivity and speed of operation to that provided with current transformers. The paper was presented by the Department (Kafedra) of Computing Techniques and Automated Control Systems (ASU), Novocherkassk Polytechnical Institute imeni S. Ordzhonikidze. Figures 4; references: 4 Russian.

[304-6508]

ELECTROACOUSTICS

UDC 620.1.05:534

AN INSTRUMENT FOR CONTACTLESS MEASUREMENT OF THE SHIFT AMPLITUDES OF ACOUSTICAL SYSTEMS

Moscow PRIDORY I SISTEMY UPRAVLENIYA in Russian No 6, 1980 pp 32-33

SYROV, N. V., engineer

[Abstract] The special design bureau for analytic instrument building (at Gomel') has developed an instrument and transducer for measurement and visualization of the oscillating characteristics of acoustical systems. When tuned to the proper frequency, the device produces a CRT display showing a continuous oscillogram of the amplitude of oscillations of the entire surface studied. Visualization of the oscillating characteristic allows not only observation of the amplitudes at various points in the acoustical system, but also observation of phase shifts of nodes and nulls, i.e., observation of the flux of oscillating energy, its absorption, loading, and scattering in various parts of the system.
[306-6508]

ELECTROMAGNETIC WAVE PROPAGATION, ELECTRODYNAMICS

UDC 537.874.6

THE EXCITATION OF REFLECTIVE GRATINGS BY A PLANE WAVE IN AN AUTOCOLLIMATION MODE

Gor'kiy IZV. VUZ: RADIOFIZIKA in Russian Vol 23, No 4, 1980 pp 479-487 manuscript received 23 Aug 79

MASALOV, S. A. and SIRENKO, Yu. K., Institute of Radiophysics and Electronics, Ukrainian SSR Academy of Sciences

[Abstract] A plane electromagnetic wave is diffracted by a periodic comb type grating consisting of infinitely fine and infinitely long ideally conducting strips. The base of the grating is made from an ideal conductor or an ideal "magnetic substance" (a case of interest to acoustics). Based on a rigorous solution of this problem of the diffraction of E and H polarized waves where the grating has a complex structure of the period, the power characteristics of the scattering in the autocollimation mode are studied analytically and numerically in this paper without significant limitations on either the parameters of the primary wave or the geometric parameters of the structure. Harmonic autocollimation reflection is possible under specified conditions and it is shown that this mode can be used for additional rarefaction of the spectrum of an open resonator where the reflectors are an ideally conducting plane and a reflective grating; such operation can also be used to attenuate interference caused by rereflections, for example, when using ground radio equipment for instrument landing and navigation systems. Figures 4; references 8: 7 Russian, 1 Western.
[245-8225]

UDC 538.3

ON THE BOUNDARY CONDITIONS FOR THE ELECTRODYNAMICS OF MOVING MEDIA

Gor'kiy IZV. VUZ: RADIOFIZIKA in Russian Vol 23, No 4, 1980 pp 470-478 manuscript received 2 Apr 79

LUPANOV, G. A. [deceased], PIKULIN, V. D. and STEPANOV, N. S., Gor'kiy State University

[Abstract] It is of interest for a number of problems in plasma physics, electronics and space electrodynamics to analyze the structure of electromagnetic fields in nonuniformity moving media, including flows with sharp boundaries (tangential

discontinuities). In the limiting case, where the thickness of the transition region (in which the velocity and other parameters of the medium change) is small as compared to the characteristic scales of the fields, it is natural to try and take into account the effect of the inhomogeneous layer by means of the appropriate boundary conditions. It is significant that in the usual situation (stationary media), the latter are universal in the sense that their form does not depend on the specific internal structure of the transition layer, and the behavior of the fields is determined only by "external" values of the medium parameters outside its bounds. The picture is more complicated in the presence of dispersion and conductivity. It is not difficult to see that in a conductive flow, the continuity of the tangential component of the magnetic field is violated because a convection surface current appears at the tangential discontinuity, where this current is caused by the drift of free surface charges induced by the field. The value of this current depends on the specific law governing the change in the parameters within the transition layer (for a specified gradient at the boundary) and the boundary condition for the tangential magnetic component is no longer universal in the above sense. This circumstance, as well as certain other fundamental issues in the problem of boundary conditions for moving media have not been duly treated in the literature; this question is considered in more detail in this paper in the light of very simple and specific models of media. The analysis is predicated on a phenomenological model of a medium described by material Minkowski relations, as well as on the example of high-frequency fields in a cold electron plasma without an external magnetic field. The influence of poles and zeros of the dielectric permittivity is considered for the latter case, although the derived analytical expressions are not followed with any numerical examples. References 12: 10 Russian, 2 Western. [245-8225]

UDC 528.12.082:53.087.92

MEASUREMENT OF THE MAGNETIC FIELD IN A FLUX OF PENETRATING RADIATION

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 6, Jun 80 pp 64-66

BUBER, V. B. and NIKHAYLOV, M. V.

[Abstract] The paper considers the special features of the measurement with the aid of an induction-type measuring transducer of a pulsed magnetic field in a flux of penetrating radiation. In order to check the results of analysis as well as to finish off the methods of measuring the magnetic fields of pulsed electron fluxes, the operation of a differential induction-type transducer with a load which assures a regime of RL-integration was experimentally investigated. The equipment on which the experiment was conducted is described. The results obtained make it possible to determine the value of the transducer load which assures a reduction of distortions to an assigned level. Thus, with the use of load resistances of 15 ohm,

distortions are decreased up to 5%. The results of the analysis conducted are also applicable to measurements with the aid of such induction-type transducers of pulse currents in a radiation flux, as for example, the Rogovskiy belt. Figures 2; references: 3 Russian. [315-6415]

UDC 532.72:538.122:537.311

NONLINEAR DIFFUSION OF PULSED MAGNETIC FIELD IN FERROMAGNETIC CONDUCTOR

Novocherkassk IZV. VUZ: ELEKTROMEKHANIKA in Russian No 7, Jul 80 pp 663-669
manuscript received 18 May 79

KIMENKO, LEV TIMOFEYEVICH, candidate of technical sciences, scientific worker,
Kharkov Polytechnical Institute

[Abstract] As shown in the literature, investigations of electromagnetic processes in conductors located in strong pulsed fields indicate that the process is significantly effected by a change of conductivity and the magnetic properties of the material which is caused by heating of the conductor and by nonuniform magnetic permeability. Here, using the assumption that the magnetization curve of a ferromagnetic conductor is ideal, the problem of permeability of a pulsed magnetic field is considered, allowing for a change of conductivity of the material. Formulas in dimensionless form are derived for calculation of current density, field intensity, induction and the electrical conductivity of the material. It is shown that neglect of the ferromagnetic properties of a conductor under the effect of a strong pulsed magnetic field, even with strong saturation of the conductor, substantially influences the process of flow of nonlinear diffusion in a pulsed regime. Figures 7; references 11: 10 Russian, 1 Western. [316-6415]

CALCULATION OF ELECTROMOTIVE FORCE INDUCED IN A COIL WITH CURRENT DURING TRANSIT THROUGH IT OF A CONDUCTING CIRCUIT

Novocherkassk IZV. VUZ: ELEKTROMEKHANIKA in Russian No 7, Jul 80 pp 683-689 manuscript received 14 Apr 78; after completion 20 Sep 79

POPOV, ANDREY NIKOLAYEVICH, candidate of technical sciences, dotsent, Omsk Polytechnical Institute; KORNEVA, NINA VASIL'YEVNA, senior teacher, Omsk Polytechnical Institute

[Abstract] Calculations are made with the use of a digital computer of the electromotive force (EMF) induced in a coil, which excites a stationary magnetic field (three different configurations of the field are considered: field of a fine coil; field of a coil of finite length; field of a coil located on the inner side of a ferromagnetic tube) with coaxial movement with great speed of a conducting circuit through the field of the coil. The results of the calculations are presented in graphic form. The following conclusions are made on the basis of the results of calculation: 1) With a decrease of the length of the coil and with the EMF maintained, the amplitude value of the induced signal increases and the maximum to the transverse plane of symmetry of the coil is shifted; 2) With an arrangement of the coil on the interior surface of a ferromagnetic tube, other conditions being equal, the amplitude value and the steepness of the signal buildup increases; and 3) The passage across zero of a signal with large rates of movement when the moving circuit does not accumulate magnetic energy coincides with the geometrical center of the coil. Figures 4; references: 4 Russian.
[316-6415]

INSTRUMENTS, MEASURING DEVICES AND TESTERS,
METHODS OF MEASURING, GENERAL EXPERIMENTAL TECHNIQUES

UDC 539.1.08:543.432

CALORIMETER FOR ABSOLUTE MEASUREMENTS OF ABSORBED DOSE OF ELECTRON EMISSION

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 6, Jun 80 pp 67-68

TSVETKOV, I. I. and POMINYKH, V. I.

[Abstract] Work was conducted at the All-Union Order of the Red Banner of Labor Scientific-Research Institute of Metrology imeni D. I. Mendeleev (VNIIM) on the creation and investigation of measuring transducers which make it possible to carry out measurements by an absolute method of an absorbed dose of electron emission in aluminum and, with a minimum rearrangement of the construction, in other materials, e.g., graphite, polystyrene and polyethylene. The object of this work was to enlarge the potentiality of a complex of standard means of measurement of the principal parameters of electron beams with electron energies up to 8.0 picojoules (50 Mev). The dosimeter constructed, which is a single calorimeter with a complex of measuring apparatus, is connected with the transducers and measuring devices of a standard complex for producing units of the electron flow—electrons/sec, and the flow of electron energy—watts. The principal units of the calorimeter are described. The experimental value of the calorimeter's sensitivity amounts to 0.2 ohm/Gram rad which corresponds to a range of measurements of an absorbed dose of 0.1--10 Gram rad. Further investigations of the calorimeter will be directed to refinement of the conditions for producing a unit of the absorbed dose in various materials. Figure 1; table 1; references: 3 Russian.
[315-6415]

CONCERNING CLASSIFICATION OF METHODS FOR MEASUREMENT OF FREQUENCY DEVIATION

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 7, Jul 80 pp 59-61

BAZAS, Yu. N.

[Abstract] The following methods are considered for measurement of frequency deviation: 1) Method of frequency detector; 2) Method of measurement of beat-frequency heterodyned frequency-modulated oscillations; 3) Method of stable ellipse; 4) Method of zero beats; 5) Method of pulsing ellipse; 6) Method of determining the index of modulation with respect to the components of the spectrum of FM oscillations; and 7) Method of determining the frequency deviation by the width of the frequency band between the components which have maximum amplitudes. A classification of the methods is proposed. It is pointed out that the proposed terminology and classification are not definitely stationary and reflect the point of view of the author. Figures 3; references 24: 17 Russian, 7 Western.
[13-6415]

INVESTIGATION OF STRAIN RESISTORS WITH IMPACT EXTENSION IN ELASTIC REGION

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 7, Jul 80 pp 40-41

KISELEV, Yu. I., LUPINSKIY, M. M., SAVITSKAYA, I. F. and SAVITSKIY, P. S.

[Abstract] In the literature the question of the effect of the speed of loading on the sensitivity of strain resistors is insufficiently illuminated. In connection with them the question often arises concerning the possible use of the results of static calibration during measurement of deformations and strains under conditions of dynamic loading. In the present paper, the elastic deformation and sensitivity are measured of wire strain resistors mounted on cylindrical specimens, in static and impact regimes. The relative deformation of a specimen and a strain resistor is considered. The measurement method is described with the aid of a cutaway drawing of the test device, and the results of measurements are given in a table. Failure of the strain resistors was not observed in the experiments. However, from the data presented it is impossible to judge concerning the behavior of strain resistors in the case of lengthy periodic loading. It is possible here for departures from static characteristics to develop because of a change of the properties of the material used in mounting the strain resistors. Figure 1; table 1; references: 3 Russian.
[13-6415]

THERMOSTABILIZATION OF INTEGRATED SILICON STRAIN TRANSDUCERS

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 7, Jul 80 pp 41-43

GRIDCHIN, V. A. and BERDINSKIY, A. S.

[Abstract] The possibility is considered of thermostabilization of silicon integrated strain transducers (IST) of the girder type with the aid of an integrated heating resistor. The data obtained can also serve as a basis for evaluation of the applicability of the method in the case of other design decisions for strain transducers. The results of experiments demonstrate that thermostabilized IST assure high temperature stability of the parameters of bridge strain-sensitive circuits over a wide range of temperature in those cases when the thermal resistance of the IST is sufficiently large. The value of the thermal resistance plays a conclusive role during selection of the method of thermostabilization in question. Figures 3; references: 5 Russian.
[13-6415]

DIGITAL MEASURERS OF THE TIME PARAMETERS OF PULSE SEQUENCES

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 6, Jun 80 pp 49-51

OVHCARENKO, A. I.

[Abstract] The method of linear scanning of the phase of the measurable parameters is used in the case of relatively low frequencies of a pulse sequence in order to increase the speed of response of measurers of pulse frequencies. The present paper demonstrates that it is also advisable to use this method during the construction of digital measurers of other time parameters of pulse sequences--the off-duty factor and the duty cycle. Measurers are considered which have small static errors (not more than a tenth part of a percent), which have a good speed of response and are easily realized on the basis of integrated circuits. The results of the work found use during the development of digital tacheometers with frequency velocity transducers and digital torque meters with phase momentum transducers. Figures 2; references: 9 Russian.
[315-6415]

DIGITAL PHASE-DIFFERENCE TORQUE METER

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 7, Jul 80 pp 37-39

ZAV, P. N.

[Abstract] A digital phase-difference torque meter is proposed, intended for use in the measurement of the variable moments of low-speed equipment. The device is based on the use of information concerning the steepness of the leading harmonic signal for forming pulses which quantize a time interval proportional to the moment being measured. These pulses are produced during attainment by a signal leading in advance with respect to phase, of established levels which are synthesized with the aid of a controlled functional digital-analog converter. The method of operation of the proposed torque meter is shown. Figures 2; references: 8 Russian. [13-6415]

DIGITAL PHASE DETECTOR

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 6, Jun 80 pp 47-49

MINTS, M. Ya. and CHINKOV, V. N.

[Abstract] A proposed digital phase detector is described, which differs from existing devices in that measurement of phase takes place between opposite transitions of the output signals through zero. Thus a constant artificial phase shift of 180° is introduced. This makes it possible to increase the precision and sensitivity of the detector without a significant increase of the frequency of one of the pulse generators used in the device. In the proposed circuit, when the phase shift angle ϕ_0 is small a phase shift close to 180° is actually measured. In a correction regime, the 180° phase shift introduced is automatically eliminated. It is concluded that the digital phase detector considered assures a higher precision of measurement in the case of a wide class of input signals. The results obtained can be used during the design of the phase detectors of phase measuring devices and various kinds of precision systems with FM signals. Figures 2; references: 2 Russian. [315-6415]

WEIGHTED MEASURER OF SMALL REACTIVE FORCE

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 7, Jul 80 pp 35-37

BOKOB, S. S., VISHNEVSKIY, A. M., GAVRILOV, P. V., KONYAYEV, B. A., MIRONOV, O. N. and ORLOVA, G. S.

[Abstract] During investigation of ion and plasma accelerators, one of the important parameters is the reaction force of exhaust jets. It is shown in the literature that design of a weighted measurer of a small reactive force makes it possible to determine fuel consumption by means of a micromotor, thanks to a change of the mass of the object which is found on the weights. However, for torsional weights with a horizontal wire, the mass of the object is restricted by the strength of the filament. In order to detect the reaction forces of plasma and ion accelerators of fairly large mass (up to 100 kg) with simultaneous measurement of fuel consumption, the authors worked out a design on the basis of weights of the rider type. The design and the metering circuit of the device are described. It is concluded that the measurer developed makes it possible to measure the reactive force acting on an object with a mass up to 100 kg with the ratio of the force to the weight of the object not less than 10^{-4} . In the range $10^{-2} \leq F_I \leq 10^{-1}$ N the measurement error amounts to $\pm 1.5 \cdot 10^{-3}$ N with delivery to the object of a total current up to 200 A and a voltage supply to the object up to 5 kV. The device can be used for measurement of the small reactive force and the fuel consumption of ion and plasma accelerators, as well as in conducting thermophysical investigation of objects in a vacuum. Figures 3; references 3: 2 Russian, 1 Western.

[13-6415]

PRECISION CRITERIA DURING SPATIAL VIBRATION TESTS

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 7, Jul 80 pp 32-34

BOZHKO, A. Ye. and SHPACHUK, V. P.

[Abstract] During laboratory vibration strength tests, it is necessary to create mechanical stresses in the object under test which appear in the exploitation process and characterize the connection between the effect on the object and the damage originating in it. Because in laboratory conditions a specified regime of vibration tests is produced by the control system of a spatial vibration table, the problem of formalization of the perturbation of the applied object is topical inasmuch as on the basis of its solution it is possible to formulate requirements on the information-measuring systems and to select quality criteria for the control system. Consequently, precision criteria during spatial vibration tests are presented in this paper and a specific example is worked out. Figure 1; references 4: 2 Russian, 2 Western (in translation).

[13-6415]

CONCERNING ERRORS OF MEASUREMENT OF TIME INTERVALS BY THE PULSE COUNTING METHOD

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 7, Jul 80 pp 30-32

MINTS, M. Ya. and CHINKOV, V. N.

[Abstract] In the case of measurement techniques the problem of evaluation of the error of measurement of time intervals by the pulse counting method is topical and is discussed in a number of works. A method of analysis of such errors with the use of characteristic functions has been proposed. This method proves to be convenient when the range of the interval being measured (e.g., because of the presence of interference) is considerably larger than the period of the counting pulses (quantum). At the same time, in measurement practice the situation is of great interest when the range of the intervals being measured is of the order of a quantum or even less. In the present paper a method is proposed for analysis of the error of quantization of the derived distribution functions of a time interval (with any relationship between the quantum and the range of values of the interval being measured). This method is based on the direct use of the distribution function of the quantization error. Figures 2; references: 3 Russian.

[13-6415]

DEVICE FOR MEASUREMENT OF SHORT-DURATION FREQUENCY INSTABILITY

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 7, Jul 80 pp 29-30

YEFIMOV, G. V., SOLOV'YEV, V. S., FERTIK, N. S. and SHAPOROSTOV, A. I.

[Abstract] In a previous paper, of which G. V. Yefimov is the principal author, a method is proposed for measurement of the characteristics of short-duration frequency instability. Use of this method simplifies the measurement processes and treatment of the results, expands the possibilities of the measuring equipment and increases precision in the case of small intervals of measuring time. A simplified block diagram is presented of the developed device, and a variation of it, intended for measurement of the instability of the difference of the emission frequencies of two lasers, is considered. The device uses the method of band filtration of a signal from the output of a frequency discriminator. Figure 1; table 1; references 3: 2 Russian, 1 Western.

[13-6415]

PHASE MEASUREMENTS OF DISCONTINUOUS SINUSOIDAL VOLTAGES AT LIMITED INTERVALS OF OVERLAP

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 7, Jul 80 pp 54-55

RUDYK, V. D., PYATIN, S. I. and DRYUCHIN, A. A.

[Abstract] Known measurers intended for operation with signals of limited duration realize the principles of processing of both 1) The instantaneous value of a phase shift transformed in a time interval; and 2) The signal in question and the reference signal, neutralized at the interval of overlap. Because of the decrease of the number of read-outs of the magnitude ϕ and the effect of transient processes, 1) does not make it possible fully to use the possibilities of the signal. However, 2) which is based on a 1974 certificate of authorship by S. I. Pyatin and V. D. Rudyk, is partially free from the shortcomings mentioned and is simpler in realization. A block diagram of the proposed measurer and an algorithm for forming the optimum measuring interval are presented. This algorithm makes it possible to select a measuring interval equal to the maximum whole number of periods of harmonic oscillations in the interval of overlap and assures a setting-up time with a duration of one pulse. Figures 3; references: 2 Russian. [13-6415]

ANALYSIS OF THE ERROR OF MEASUREMENT OF THE PARAMETERS OF MECHANICAL VIBRATIONS

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 7, Jul 80 pp 14-16

PEDOTOVA, G. V.

[Abstract] Heterodyne interference methods are the most acceptable for measurement of the parameters of mechanical vibrations of complex form. At present various measuring heterodyne systems are used, among which systems with a two-frequency sources of radiation are most often encountered. In the present paper an analysis is made of interference heterodyne systems for the exposure of possible sources of error in the limits of their optical circuit and their effect on the error of measuring the rate of mechanical vibrations, as well as an analysis of various versions of the interference schemes of a heterodyne measuring system. Figures 1; tables 1; references 6: 3 Russian, 3 Western (2 in translation). [13-6415]

ERRORS OF CERTIFICATION OF MODELS OF NEUTRAL LIGHT FILTERS

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 7, Jul 80 pp 11-14

SELEZNEV, A. A.

[Abstract] Photoelectric absorptiometers are widely used in many sectors of industry. They are checked against a set of models of neutral light filters (MNLF). The set consists of eight neutral absorbers certified by metrological organs according to the average spectral coefficients. Certification is conducted by a method, the essence of which consists in measurement of the spectral transmission coefficients of the MNLF on a spectrophotometer, analysis of the data obtained and calculation of the average spectral transmission coefficients of a light filter in the spectral band selected for each type of device. The spectral band is determined by the characteristics. In the present paper a quantitative evaluation is given of the total error of certification, and the source of the origin of errors is considered. Tables 4; references: 8 Russian.

[13-6415]

AN AUTOMATIC SYSTEM FOR MEASUREMENT AND REGULATION OF PRESSURE

Moscow PRIMORY I SISTEMY UPRAVLENIYA in Russian No 6, 1980 p 29

CHERTYKOVTSSEV, V. K., engineer, and YAGOVKIN, G. N., candidate of technical sciences

[Abstract] The Kuybyshev Polytechnical Institute has developed a simple and reliable system for measurement and regulation of pressure, which meets the requirements of high accuracy and reliability under production conditions with significant changes in temperature, humidity, and other parameters. The system consists of a differential induction transducer, a power supply, a measurement bridge, an analog-digital converter, a computing unit, automatic control unit, and a discriminator. A photograph and block diagram of the instrument are presented, as well as a brief description of its operation and a list of technical characteristics: maximum measured pressure, 100 atm. gauge; 10 measured objects; error not over 0.1%, maximum distance from device to measured object up to 5 km; power consumption not over 10 W; power required $220 \pm 20\%$ (50 Hz); size 235 x 90 x 100 mm; mass 5 kg. Figures 2; references: 3 Russian.

[306-6508]

MATERIALS

UDC 537.856

APPROXIMATE CALCULATION OF THE SURFACE EFFECT IN A CYLINDRICAL CONDUCTOR OF FERRO-MAGNETIC MATERIAL

Novocherkassk IZV. VUZ: ELEKTROMEKHANIKA in Russian No 7, Jul 80 pp 677-682 manuscript received 5 Jul 79

YEDUSH, VLADIMIR YAKOVLEVICH, candidate of technical sciences, dotsent, Taganrog Radio Engineering Institute

[Abstract] The known procedure for calculating the surface effect in a cylindrical conductor with a linear connection between the induction B and the intensity H of the magnetic field is based on the solution of a Bessel equation. In the present paper, the possibility is considered of an approximate calculation of the surface effect in a steel conductor of circular cross section, taking into account a specified nonlinearity of the dependence of the induction B on the intensity H of the magnetic field. The calculation is conducted by the method of finite elements and iteration with the use of Maxwell equations in a complex form of notation. In this connection, the circular cross section of the conductor is divided into n elementary sections, during which in the limits of an elementary section the permeability μ is considered to be constant. During calculations, losses caused by hysteresis and magnetic viscosity are disregarded, i.e., it is assumed that μ is real and not a complex magnitude. Figures 3; references: 4 Russian.
[316-6415]

UDC 620.179.14:669.017

NEW METHOD OF CHECKING STEEL AND CAST IRON BY THE SPECTRAL CHARACTERISTICS OF THE ENVELOPE OF MAGNETIC NOISE

Novocherkassk IZV. VUZ: ELEKTROMEKHANIKA in Russian No 7, Jul 80 pp 715-719 manuscript received 16 Jan 80

ANDRIANOVA, LIDIYA VASIL'YEVNA, engineer, Rostov Institute of Agricultural Machine Building

[Abstract] The problem of the use of magnetic noise arose in connection with use of the Barkhausen effect in nondestructive checking. Interest in this direction required development and exploitation of magnetic noise apparatus for nondestructive

checking which uses information concerning the envelopes of magnetic noise. In the present paper two methods for spectral representation of a linearized signal of an envelope of magnetic noise are considered: with the assistance of a delta function (strobing method) and a Fourier series. An equation is derived which makes it possible with the aid of a computer to calculate the dependences between the spectral characteristics of an envelope of the magnetic noise of ferromagnetic materials and their structures and the physico-mechanical properties in terms of the magnetic noise characteristics. Diagrams are presented of a comparative evaluation of the response of the spectral and magnetic noise characteristics of various types of steel in terms of the structural-phase state and the physico-mechanical properties. Diagrams are also presented of the response of the separate harmonics of the envelope of magnetic noise, obtained experimentally for steel and cast iron in terms of their structural-phase state and physico-mechanical properties. These diagrams can be used in the form of recommendations during choice of a particular parameter of information as a function of the process being checked. Thus, for example, checking of the structure of the metallic basis of malleable cast iron, in the conditions of the Lyuberets Plant of Agricultural Machines imeni Ukhtomskiy, is carried out in accordance with four harmonics. Figures 3; references: 4 Russian. [316-6415]

UDC 621.1

PROBLEM OF MAGNETIC SUPPORT IN THE LIGHT OF THE USE OF NEW MAGNETICALLY HARD MATERIALS

Novocherkassk IZV. VUZ: ELEKTROMEKHANIKA in Russian No 7, Jul 80 pp 703-709

PYATIN, YURIY MIKHAYLOVICH, doctor of technical sciences, professor, Moscow Road Transport Institute

[Abstract] The contemporary stage of development of magnetically hard materials is characterized by two distinctive features: 1) The beginning of wide use of magnets from rare-earth materials (REM) of class RCO_3 where R is a rare-earth element (Sm, Pr and others); and 2) Opening of the possibility of further significant progress of REM magnets by transition to compounds of class $R_2(Co, Fe)_{17}$ and some others. A survey is presented of the achievements in the creation of new materials of this kind. The prospects for an improvement of magnetic support (magnetic suspension) by means of the new magnetic materials are discussed. It is concluded that in magnetic supports the magnets must have the form of thick films. Production of such magnets by the sintering method is only possible on condition that the annular magnets consist of a set of elementaries. Consequently, in those cases where there are no rigorous limitations on the dimensions of the suspension, it is necessary to cut out magnets from compositions of REM powders with plastic binders. At present such magnets are produced in the form of sheets from which it is possible to stamp film magnets of any form. With respect to specific energy, compositions of REM are not inferior to the best makes of cast alloys of Alnico and with respect to coercive force considerably surpasses them. Figures 5; table 1; references 5: 3 Russian, 2 Western.

[316-6415]

THE STATE OF THE ART IN ELECTRON-BEAM EQUIPMENT (REVIEW OF FOREIGN DATA)

Moscow MIKROELEKTRONIKA in Russian Vol 9, No 4, Jul/Aug 80 pp 310-318 manuscript received 17 Jan 80

SATAROV, G. Kh., BLINOV, I. G. and GARYAYEVA, G. O.

[Abstract] Electron-beam equipment produced outside the USSR and designed to generate the topology of IC's is surveyed: data are given for the cathode material, the beam current density, the shape and size of the beam, the minimum size of a topological element in micrometers, the clock frequency, the scanning field, the positioning precision, the rate of table travel as well as the productivity in chips per hour and the cost for units built by the following companies: ETEC Corp., IBM, Varian/Extrion, Cambridge Scientific Instruments, JEOL (Japan), Toshiba, Hitachi and Carl Zeiss Jena (GDR). The conclusions drawn from the comparisons are: While this equipment is presently used for the fabrication of intermediate templates for products with a high level of integration, the productivity of the equipment with the requisite precision of 0.1 micrometers is inadequate for industrial manufacture of IC's with direct electron beam exposure of silicon chips. The most productive method of processing the chips is vector scanning with a rectangular, variable geometry beam. The most universal method and one which is simplest to control is circular beam processing using vector scanning, which is also the least productive, requiring point by point processing of the product. The control computer memory capacity should be increased substantially to improve productivity. The high cost and low productivity are the major limiting factors for the use of electronic lithography in the mass production of IC's. Table 1; references: 20 Western. [305-8225]

A STUDY OF THE RELIABILITY OF THE GATE DIELECTRIC OF MOS STRUCTURES

Moscow MIKROELEKTRONIKA in Russian Vol 9, No 4, Jul/Aug 80 pp 347-355 manuscript received 23 Aug 79

LASHEVSKIY, R. A., FILARETOV, G. A. and SHAPIRO, L. A.

[Abstract] MOS capacitors were used as test structures in a study of the reliability of the gate dielectric in MOS large-scale integration (LSI) circuits. The dielectric of the test structure matched the gate dielectric of LSI circuits for all practical purposes (the length and shape of the boundary between the thick-thin dielectrics, the presence of diffusion regions in the substrate). The area of the dielectric was 0.8 mm^2 and the thickness was $1,400 \text{ \AA}$. The dielectric was obtained by oxidation of a silicon chip cut along the (111) plane in dry oxygen at $1,150^\circ\text{C}$ with subsequent phosphorus passivation. The capacitors had an aluminum electrode 0.8 to 1.0 micrometers thick. The samples were mounted in metal-glass packages without being hermetically sealed. The tests consisted of long term-simultaneous application of a DC voltage and temperature to the thin oxide. The temperature range was 125 to 180°C and the voltages ranged from 30 to 70 volts. Experimental curves were found for the failure rate as a function of time, temperature and voltage. Three different sections were observed for the failure rate as a function of time. In the first two, the failure rate falls off in inverse proportion to time; in the third, the rate increases monotonically. Temperature influences the duration of the first, and probably also the second. The duration of the first section is reduced with an increase in the temperature as an inverse exponential function. The activation energy for this process is 0.7 eV . The experimentally found curve for the failure rate as a function of voltage is close to a fifth power law. The tests were run for as long as $6,000$ hours. It is concluded that there is a common mechanism for the degradation of the dielectric in the temperature and voltage ranges of the experiments; the efficacy of the use of elevated temperatures and voltages for accelerated reliability testing of a gate dielectric, as well as for quality control and thermal and electrical break-in of MOS LSI structures is evaluated. Figures 7; references 12: 5 Russian, 7 Western.

[305-8225]

ION ETCHING OF MICROSTRUCTURES IN THE PRODUCTION OF VERY LARGE SCALE INTEGRATED CIRCUITS

Moscow MIKROELEKTRONIKA in Russian Vol 9, No 4, Jul/Aug 80 pp 302-309 manuscript received 17 Jan 80

DANILIN, B. S. and KIREYEV, V. Yu.

[Abstract] The production technology for very large scale integrated circuits (VLSI) with an integration level of no less than 10^6 elements per chip and submicron dimensions (down to 0.2 micrometers) requires that traditional chemical etching of the working materials in order to transfer the patterns from the resistive masks be replaced. There are three major types of etching using high energy or chemically active particles for this: ion etching, plasma chemical etching and ion chemical etching. These techniques are analyzed with primary attention devoted to ion etching. The high degree of anisotropy of ion etching permits the transfer of submicron dimensions from the masks to the layers of the working materials. The advantages of polymethylmethacrylate for the electron or X-ray resist layers (a two to three times faster etching rate for most materials with the exception of Au, Ag, Cu and Pt and a possible resolution of 0.2 micrometers) are discussed as applied to ion etching, as well as techniques of mask transfer and improving the strength and reducing the thickness of the resistive masks. Etching rates, depths and pressures are compared in tabular form for various materials. Despite the high resolution, universality, safety and sterility of the process, the poor selectivity and etching rate, reprecipitation effects and the dependence of the rate on the ion incidence angle as well as the considerable thermal and radiation impact on the structure being treated all limit the application of ion etching to VLSI production. Such etching processes, primarily ion beam etching are used to fabricate microstructures in those materials for which plasma chemical and ion chemical techniques have not been developed. The major application of ion etching at the present time is to devices using lithium niobate, orthoferrites, garnet and magnetic bubbles. Figures 6; tables 2; references 22: 5 Russian, 17 Western.

[305-8225]

DIFFRACTED LIGHT ELLIPSOMETRY

Moscow MIKROELEKTRONIKA in Russian Vol 9, No 4, Jul/Aug 80 pp 319-329 manuscript received 17 Jan 80

YEGOROVA, G. A., LONSKIY, E. S., POTAPOV, Ye. V. and RAKOV, A. V.

[Abstract] The production by 1985 of very large scale integrated circuits (VLSI) with topological elements as small as 0.5 to 0.7 micrometers will require the measurement of the refractive index and the thickness of thin dielectric films for one topological figure. Reducing the dimensions of the local regions to be measured is difficult because of diffraction phenomena which impair the reproducibility and precision of the results. The minimum surface area of an object which can be illuminated by a sharply focused optical source, directed obliquely to the surface, is estimated, and it is shown that the resolution of 4 to 5 micrometers obtained by standard ellipsometric techniques is inadequate. This can be overcome by measuring the polarization characteristics of the light reflected from the test structure. This paper derives an approximate ellipsometric equation for a grating; the good sensitivity of the polarization characteristics of the reflected light to individual parameters of the lattice is demonstrated and preliminary experimental data are obtained which are found to be in good agreement with the theory. The theoretical analysis treats a grating consisting of alternating bands of SiO_2 of various thicknesses on Si. The experimental study used 2 gratings which took the form of reflective chromium strips on glass with an overall grating size of $1 \times 1 \text{ mm}^2$ and $5 \times 5 \text{ mm}^2$ with periods of 100 and 20 micrometers respectively. The templates were used to obtain the corresponding photolithographic prints on a silicon substrate coated with a thermal oxide, with subsequent etching of the oxide strips to various depths. Several amplitude-phase gratings were made in this fashion. The ellipsometric parameters of the light beams diffracted from the gratings for various diffraction orders were determined experimentally, where the light was incident to the plane of the grating at an angle of 70° . The design of the unique ellipsometer used in the study is described and the experimental curves for the ellipsometric parameters are also plotted. The effect of the strong change in the polarization parameters of the light reflected from the gratings for various grating orders is caused by the presence of regions in the diffraction gratings which correspond to the appearance of an additional region in the equivalent plane of the grating at the boundary between the markings, where this additional region has an optical density differing from the density of the regions associated with the main lines of the grating. The authors thank L. S. Mednikov for making numerical calculations on a computer and T. V. Sadoy for conducting certain experiments. Figures 7; tables 3; references 11: 7 Russian, 4 Western.

[305-8225]

THE DEVELOPMENT AND POSSIBILITIES OF WAYS FOR PRODUCING MICROSTRUCTURES

Moscow MIKROELEKTRONIKA in Russian Vol 9, No 4, Jul/Aug 80 pp 330-339 manuscript received 17 Jan 80

YANUSHONIS, S. S.

[Abstract] Various technological procedures are used in the production of microstructures: photolithography, electron and X-ray lithography as well as autoforming and automatching. Automatching is a general term applied to any process where the boundary in one layer is transferred along an axis perpendicular to the layer to another layer joined to it; examples are isoplanar technology and permanent mask techniques. Microstructure forming schemes found in western and Soviet patent literature are discussed; it is shown that autopositioning and autotransformation are special cases which can be subsumed under the label of autoforming, while the planar technologies are a special case of automatching. This categorizing discussion is followed by an analysis of the dimensional errors in microstructures and equations are derived for the minimum dimensions of structures which can be achieved using the various forming methods. The critical size of a structure is found, at which autoforming is preferable to all other forming techniques. Automatching allows for a smaller spacing between the structures where the absolute error in the matching is greater than the absolute error in the size of the original structure. At the present state of the art, automatching permits a reduction in the spacing between structures by a factor of three. The critical size of a structure, below which the autoforming precision is greater than that of photolithography and electron lithography can be estimated at 2 micrometers for the former and 0.5 micrometers for the latter with present day technology. Because autoforming is a parasitic phenomenon in photo and electron lithography, the problems inherent in autoforming are anticipated in this case with a further reduction in the dimensions of microstructures. Figures 5; references 21: 4 Russian, 17 Western. [305-8225]

A CONTROL CIRCUIT FOR TIMED I^2L DEVICES

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 7, Jul 79 pp 88-89 manuscript received 7 May 79

POMICHEV, A. V., PONOMAREV, M. F. and KONOPLEV, V. G.

[Abstract] A new control circuit is suggested for synchronous logic elements, flip-flops, registers and other timed I^2L devices. In the circuit suggested, when the clock pulse T11 arrives, the current of transistor V1 charges capacitance C1 of the

emitter junction of transistor V2. After completion of clock pulse T11, clock pulse T12 is applied to the emitter of transistor V3, the collector current of which charges capacitor C2. Transistor V4 is opened and rapidly discharges capacitor C1. Capacitor C2 is similarly discharged rapidly through transistor V5 when clock pulse T11 is again applied. Computer modeling shows that the suggested control circuit has approximately one-third the delay time of the ordinary circuit. Figures 2; references: 1 Russian.
[309-6508]

OPTOELECTRONICS, QUASI-OPTICAL DEVICES

UDC 621.382

THE OPTRON INDICATOR—A NEW OPTOELECTRONIC DEVICE

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 6, 1980 p 32

NOSOV, Yu. R., doctor of technical sciences, and MIRONENKO, A. N., engineer

[Abstract] It has been found that the use of anti-Stokes luminophors makes it possible to combine in a single element the functions of an optron optical switching decoupler and an indicator element in order to reflect the status of the isolated circuit. A photograph of the miniature element which achieves this function is presented. Figure 1.

[306-6508]

POWER SYSTEMS (INCLUDING EFFECT OF VARIOUS
ITEMS ON POWER TRANSMISSION)

UDC 621.316.1:681.3.06

A SYSTEM OF PROGRAMS FOR INFORMATION SUPPORT AND CONTROL OF THE ELECTRIC POWER
NETWORKS OF CITIES

Minsk IZV. VUZ: ENERGETIKA in Russian No 6, Jun 80 pp 28-33 manuscript received
20 Mar 79

NICHIPOROVICH, L. V., candidate of technical sciences, ULASEVICH, A. F., engineer

[Abstract] The Belorussian Polytechnical Institute and "Belglavenergo" [Main Administration of Power, Belorussian SSR] have developed a software system for the YeS series of computers, which is intended for information support and switching control of city electric power networks. The system consists of a group of programs for a data base management system (DBMS) plus a number of programs for performance of specific tasks. The main requirement utilized in development of the DBMS is assurance of the possibility of stage-by-stage creation of the information model which is intended for solution of the simplest tasks in evaluation of the status of the network, with subsequent development for tasks of optimization, planning, retrospective analysis of operations, etc. The DBMS permits the creation of a data base with the necessary structure and volume, including standard reference files and files of semipermanent technological information, to be stored on magnetic discs. The relationships between entries concerning specific objects in the data base are diagrammed. This software system was used to create a data base of information about the 6-10 kV distributing networks of the city of Minsk. The logical organization of the information in the data base is diagrammed. The DBMS is upward expandable. The paper was presented by the Department (Kafedra) of Electrical Supply for Industrial Enterprises. Municipalities and Agriculture, Belorussian Polytechnical Institute; and "Belglavenergo." Figures 3; table 1; references: 3 Russian.

[304-6508]

INFORMATION-MEASURING PROBLEM OF POWER CONVERSION TECHNIQUES

Novocherkassk IZV. VUZ: ELEKTROMEKHANIKA in Russian No 7, Jul 80 pp 760-761 manuscript received 4 Apr 77

VOLGIN, LEONID IVANOVICH, doctor of technical sciences, acting professor, Ul'yanovsk Polytechnical Institute; and MATCHAK, ANDREY TEODOROVICH, candidate of technical sciences, head of laboratory, Scientific-Research Institute of Tallinsk Electrical Engineering Plant imeni M. I. Kalinin

[Abstract] Problems concerned with the information-measuring provisions of power conversion techniques (PCT) are described and a number of questions on RCT subject to consideration from the point of view of the theory of information-measuring systems are outlined. References: 6 Russian.

[316-6415]

ANALYSIS OF THE OPERATION OF A FREQUENCY COMPARATOR

Minsk IZV. VUZ: ENERGETIKA in Russian No 6, Jun 80 pp 100-103 manuscript received 13 Feb 80

BENIN, V. L., doctor of technical sciences, professor, and BORISENKO, A. N., engineer

[Abstract] An analysis is presented of the operation of a frequency comparator designed for comparison of the frequencies of two trains of pulses of any shape, fed to its two inputs. Time diagrams of the operation of the frequency comparator plus a functional diagram are presented. The operation of the comparator is studied for sequences of pulses of triangular and trapezoidal shape; however, the device operates similarly for any pulse shape. The paper was presented by the Department (Kafedra) of the Theoretical Basis of Electrical Engineering, Khar'kov Order of Lenin Polytechnical Institute imeni V. I. Lenin. Figures 2; references: 2 Russian. [304-6508]

UDC 621.375.826.08:551.521.3

MEASUREMENT OF WAVE LENGTH OF TUNABLE LASERS

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 6, Jun 80 pp 26-28

DROZHBIN, Yu. A., PROKOPENKO, V. Ye., RASS, L. A., STEPANOV, B. M. and YUROV, V. T.

[Abstract] The construction principles and the design features are considered of equipment for measuring with increased precision the wavelength of the pulsed and continuous radiation of tunable lasers. With the special features of operation of tunable lasers taken into consideration, the following requirements are imposed on the equipment: wide spectral operating range; high-speed operation because of automatization of measuring process; frequency operating conditions; and high precision of measurement of radiation wavelength. The measuring equipment has a two-channel circuit. In the first channel "rough" measurement is made of the radiation wavelength in question, and in the second channel it is refined. The spectral operation range of the equipment is limited by the spectral operation range of the individual elements and it amounts to 0.36--0.8 micrometer. Figures 2; references: 7 Russian.
[315-6415]

UDC 621.391.2:621.396.96

POLARIZATION SELECTION OF RADAR SIGNALS AGAINST A BACKGROUND OF ACTIVE JAMMING

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 4, Apr 80 pp 98-101 manuscript received 26 Mar 79

NGUYEN ZI LIN'

[Abstract] The signal-to-noise + interference ratio ($S/N+I$) at the output of the linear section of a receiver depends substantially on the relationship of the polarization parameters of the signal, interference and the polarization selector. The impact of interference on the reception and processing can obviously be minimized by varying the polarization parameters of the signal and selector. This paper treats the case of active jamming and solves the problem of the combined selection of the polarization parameters of the transmitted signal and the selector which maximize the $S/N+I$ ratio at the selector output. It is assumed that the transmitting and receiving antennas have mutually orthogonal polarization and that the (2×2) dimensional scattering matrix of the target and the correlation matrix of the jamming are known. These matrices are assumed to be steady-state. The mathematical analysis generates an equation for the maximum attainable gain in the case of jamming with a specified level of polarization, where this gain is expressed as the ratio of the $S/N+I$ at the selector output to the $S/N+I$ at the selector input. It is shown that if the level of jamming polarization is sufficiently high, there is the theoretical possibility of cutting out the interference, even complete suppression, by means of the appropriate control of the polarization of the transmitted signal and selector. Figures 3; references 7: 6 Russian, 1 Western.

[258-8225]

THE APPLICATION OF INTERPERIOD COMPENSATION IN SHORTWAVE OVER THE HORIZON RADARS

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 4, Apr 80 pp 89-91 manuscript received 7 Feb 79

KITAYEV, V. V.

[Abstract] Interperiod compensation for passive jamming is utilized for moving target indication in radars. This paper analyzes the possibility of the application and the effectiveness of such compensation for a shortwave radar. Analytical expressions are presented for the spectra of the useful signal, the passive interference and the sounding signal. The magnitudes of these spectra under typical over the horizon (OTH) radar conditions are treated in light of experimental data from such sources as oblique sounding of the ionosphere. The parameter which best characterizes the improvement in the signal-to-interference ratio with interperiod compensation is the subnoise visibility factor, K_{pv} . K_{pv} is plotted as a function of the doppler signal frequency for second and third order Chebyshev filters. Under conditions characteristic of OTH shortwave radars, the use of digital recursive filters for a moving target indicator provides a power gain throughout the entire range of doppler frequencies, and in this case, K_{pv} is a more uniform function of the doppler frequency than for classical interperiod compensation circuits. Thus, this type of compensation can be effectively utilized in OTH radar systems. Figures 2; references: 10 Russian, 1 Western in translation. [258-8225]

AN ANALYSIS OF THE PRECISION IN TAKING A BEARING ON RANDOM FIELDS USING DUAL CHANNEL MONOPULSE SYSTEMS WITH A PHASE METER

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 4, Apr 80 pp 107-110 manuscript received 30 Jan 79

RYBAKOV, B. S.

[Abstract] The precision in the direction finding (DF) of random Gaussian fields with the use of two-channel monopulse systems are analyzed for the following four system configurations: AF, FF, AA and FA (the first letter designates the type of antenna transducer and the second the type of meter where A stands for amplitude and P for phase). The following assumptions are made for the mathematical analysis: the field of the random component is normal and homogeneous with a specified correlation function in the plane of the apertures of the receiving antennas, while the field of the regular component is specified in terms of its amplitude, phase, and the spatial correlation radius. The noise appears in the channel at the output of

the antenna transducer and is additive, normal, and cross-correlated having a zero mean value and a known dispersion. The bearing is taken only in one plane while the apertures of the receiving antennas are linear with an angular or spatial separation. The derived equation is a generalization of a well-known formula from the literature for the case of an arbitrary ratio of the powers of the regular and random signal components, as well as the presence of a so-called "phase difference," which is due to the fact that the scattered field component in randomly inhomogeneous media frequently does not propagate via a coherent path. The results of a numerical analysis of the DF errors of monopulse systems are given, where the errors are defined as the ratio of the dispersion of the signal at the meter output to the slope of the average DF characteristic. This ratio is plotted graphically for AF and FF systems as a function of the degree of spatial distortions of the field. A comparison of all methods yields the following ranking in terms of DF precision: AA, AF, FA, FF--where the best system is AA with logarithmic processing and the worst is FF. Figures 3; references: 4 Russian.
[258-8225]

UDC 621.391.2

ESTIMATE OF THE INFORMATION CONTENT OF RADAR SIGNALS

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 7, Jul 79 pp 75-77 manuscript received 5 Sep 78; after revision 3 Sep 79

KOSENKO, G. G.

[Abstract] Given a sequence of classes of radar objects and their a priori probability of appearance in the zone of radar observation, and a radar signal with a predetermined set of parameters, with additive noise, independent with respect to the set of parameters of the signal, the problem is stated of estimating the quantity of information contained in the signal concerning the classes of radar objects, from the standpoint of sufficiency of the information for recognition of the objects. A structural diagram of an analyzing device utilizing this principle is presented. The device utilizes the parallel method of signal processing, reducing the time required for analysis but requiring additional hardware. Figures 3; references: 5 Russian.
[309-6508]

METHODS OF MONITORING SURFACE STATUS AND PROBLEMS OF MOLECULAR BEAM EPITAXY

Moscow MIKROELEKTRONIKA in Russian Vol 9, No 4, Jul/Aug 80 pp 292-301 manuscript received 6 Jun 79

RZHANOV, A. V., STENIN, S. I. and OL'SHANETSKIY, B. Z.

[Abstract] This extensive survey of Soviet and western literature reviews ways of studying the surface state of semiconductors, especially as applied to molecular beam epitaxy. A brief recapitulation of such techniques as slow electron diffraction, fast electron diffraction in a high vacuum, Auger electron spectrometry, X-ray spectroscopy and electron spectroscopy for chemical analysis and ellipsometry, as well as a few destructive tests such as secondary ion mass spectrometry is followed by a detailed treatment of problem areas in molecular beam epitaxy, including the following: 1) The structure and properties of an atomically pure substrate surface prior to epitaxy; 2) Effects on surface growth: the transition process, molecular interactions in the steady state growth stage; 3) The behavior of the doping impurity atoms during epitaxy; and 4) The formation of defects, especially during heteroepitaxy. A major stimulus in the development of molecular beam epitaxy (MBE) is the increased requirements placed on the precision in the specification of thickness and doping profiles in ultrathin film structures for microwave applications. Because the problem of deriving heteroepitaxial structures with a low defect density has been rather well studied, a problem for the immediate future is the application of the principles which have been derived to MBE. This approach can produce an entire class of quantum effect devices, including superlattices, a tunnel transistor, a resonance photocell with tunneling through a dielectric film, as well as systems for generating and converting plasma waves to hypersound, etc. The examples cited indicate that the development of MBE will open up new possibilities for the component base in microelectronics, optronics and microwave engineering. References 56: 20 Russian, 36 Western (2 in translation). [305-8225]

A STUDY OF THE PROFILE OF RADIATION DAMAGED LAYERS IN SILICON USING A PROBE CURRENT LEAKAGE METHOD

Moscow MIKROELEKTRONIKA in Russian Vol 9, No 4, Jul/Aug 80 pp 362-368 manuscript received 28 Apr 79

BULGAKOV, Yu. V. and YATSENKO, L. A.

[Abstract] The profile of the specific resistance in n- and p-Si is studied using a single probe leakage current procedure, where the probe is positioned at the surface of a spherical cut. Since this method cannot yield an accurate value of the specific resistance because precise data are needed for the size and shape of the contact surface in order to convert from the leakage resistance to the specific resistance, the set-up was precalibrated with samples having a known specific resistance. The resistance profiles for radiation damaged layers produced in silicon by helium, boron and nitrogen ions with energies from 0.49 to 4.2 MeV were studied using silicon chips with an area of $1 \times 1 \text{ cm}^2$ and a thickness of about 500 micrometers, which were secured to the semi-automatic carriage of the single probe set-up. Prior to the testing, the irradiated samples were mechanically surface polished, and ohmic contacts were made on the back surface. Tungsten carbide needles with a tip radius of about 10 micrometers were used as the probe. The set-up provided for intermittent motion of the probe with steps of 2.5 or 5 micrometers along the diameter of the spherical cut made in the sample with a 152 mm diameter ball. The leakage current resistance was measured by means of measuring the current flowing through the probe with a DC microammeter, while the voltage drop across the contact was measured with an electrometer having an input impedance of about 10^{16} ohms. The depth resolution of the technique is about 0.1 micrometers in a thickness range of 0.5 to 10 micrometers. The profile was determined as a function of the energy and type of ion, the irradiation dose and the original resistance of the sample. The values of the major parameters of the specific resistance profile (the position of the maximum, the extrapolated boundary and the half-width value) are in good agreement with theoretical results for boron and nitrogen ions. The procedure studied here permits the investigation of the defect formation process for interstitial doses at least two orders of magnitude lower than with structural methods, for example, fast light ion back-scattering. The authors are grateful to V. S. Nikolayev for constant interest in the work and for valuable discussions, as well as to I. D. Koshev for assistance in conducting the experiment. Figures 4; references 24: 6 Russian, 18 Western.

[305-8225]

ON A METHOD OF DETERMINING THE SIZE AND PROFILE OF SUBSTRATE DOPING FROM THE CHARACTERISTIC CURVES FOR MOS TRANSISTORS

Moscow MIKROELEKTRONIKA In Russian Vol 9, No 4, Jul/Aug 80 pp 340-346 manuscript received 30 Nov 79

GUZEV, A. A., GURTOV, V. A. and FRANTSUZOV, A. A.

[Abstract] When modeling the characteristics of MOS structures, it is important to know the distribution profile for the doping impurity close to the semiconductor surface. A brief discussion of methods of checking the profile of the N_D concentration in finished structures is followed by a mathematical analysis of an MOS transistor which derives equations to determine the magnitude and profile of dopant distribution based on the shift in the transistor characteristic which occurs when a voltage is applied between the channel and the substrate. The error in these determinations is due to the shift in the position of the Fermi quasi-level for the minority carriers at the surface of the semiconductor and can be large for transistors with a high density of states at the oxide-silicon boundary and those with a superfine oxide (about 100 Å). The errors inherent in the traditional methods based on the change in the threshold voltage found from the transistor characteristics for the cross-section $I_{DS} = \text{const.}$ in the weak inversion region with the substrate biased can be avoided by using a channel conductivity procedure in conjunction with the Hall effect. The experimental check of this was based on the measurement of the drain current I_{DS} and the Hall e.m.f. as a function of the voltage V_G , where V_{SS} varied from -0.3 to 16 volts. Good agreement is noted between experiment and theory and it was possible to monitor the position of the Fermi quasi-level at the surface. It is shown that the precise calculation of this profile is possible only using the proposed technique. Figures 6; references 9: 5 Russian, 4 Western.

[305-8225]

VARIOUS MISCELLANEOUS ITEMS, INCLUDING THEORIES

UDC 621.3.019.3:62

CLASSIFICATION OF METHODS OF DETERMINATION OF QUALITY INDICES OF ELECTRONIC SYSTEMS AND ELEMENTS

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 6, 1980 pp 37-38

POLUBOYARINOV, A. G., chief of All-Union Association "Soyuzprompribor", ZAVODYAN, A. V., candidate of technical sciences, and GOROSHKO, V. N., engineer

[Abstract] A study is made of the specifics of the main method for evaluation of the quality and reliability of electronic systems and elements in order to determine those characteristics which can be used for convenient classification. The following classification characteristics are found: degree of complexity, and the mathematical model upon which the system is based. Graph theory is used to place all possible models in order and determine the interconnections between them. Figures 1; references 9: 7 Russian, 2 Western (1 in translation).

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